

Annex A
(normative)

AIM EXPRESS expanded listing

The following EXPRESS is the expanded form of the short form schema given in 5.2. In the event of any discrepancy between the short form and this expanded listing, the expanded listing shall be used.

To be completed at a later date

Annex B
(normative)

AIM short names

Table B.1 provides the short names of entities specified in the AIM of this part of ISO 10303. Requirements on the use of the short names are found in the implementation methods included in ISO 10303.

Table B.1 - Short names of entities

Entity names	Short names

To be completed at a later date.

Annex C
(normative)
Implementation method - specific requirements

The implementation method defines what types of exchange behaviour are required with respect to this part of ISO 10303. Conformance to this part of ISO 10303 shall be realised in an exchange structure. The file format shall be encoded according to the syntax and EXPRESS language mapping defined in ISO 10303-21 and the AIM defined in annex A of this part of ISO 10303. The header of the exchange structure shall identify the use of this part of ISO 10303 by the schema name 'ship_mechanical_systems'.

To be completed at a later date

Annex D
(normative)
Protocol Implementation Conformance Statement (PICS) proforma

The PICS proforma is supplied for completion by the person or organisation (the client) requesting conformance testing. Its purpose is to ascertain the scope of claimed conformance to a particular application protocol by an implementation under test (IUT) using a defined implementation method. Through the completion of this form, the PICS Proforma becomes a PICS.

The information contained in the PICS is used to configure an appropriate executable test suite for use by the client.

Ten conformance classes are identified in this part of ISO 10303. A conforming implementation shall support at least one conformance class. Each class specifies a subset of ISO 10303-226 AIM constructs. These classes are detailed in clause 6 of ISO 10303-226.

Questions:

1. Please provide an identifier for the product or system for which conformance is claimed:

Product name and current version number: _____

2. Please indicate the implementation method chosen:

- ISO 10303-21 Exchange Structure - - preprocessor

Preprocessor name and current version number: _____

- ISO 10303-21 Exchange Structure - - postprocessor

Postprocessor name and current version number: _____

3. Please indicate the classes for which conformance is claimed:

- Class 1: _____

- Class 2: _____

- Class 3: _____

To be completed at a later date

Annex E
(normative)
Information object registration

E.1 Document identification

In order to provide for unambiguous identification of an information object in an open system, the object identifier:

{ iso standard 10303 part(226) version(-1) }

is assigned to this part of ISO 10303. The meaning of this value is defined in ISO/IEC 8824-1, and is described in ISO 10303-1.

E.2 Schema identification

In order to provide for unambiguous identification of the schema specifications given in this application protocol in an open information system, object identifiers are assigned as follows:

To be completed at a later date

Annex F
(informative)
Application activity model

The application activity model (AAM) is provided to aid the understanding of the scope and information requirements defined in this application protocol. The model is presented as a set of definitions of the activities and the data, and a set of activity figures. The viewpoint of the AAM is the users of ship mechanical system's information, including shipbuilder, ship designer, ship operator, equipment supplier and so on.

This AAM identifies the ship life cycle activities across all shipbuilding APs with extensions to ship mechanical systems. As such, the AAM covers activities which go beyond the scope of this part of ISO 10303.

F.1 Application activity model definitions

The following terms are used in the application activity model. Terms marked with an asterisk are outside the scope of this application protocol.

The definitions given in this annex do not supersede the definitions given in the main body of the text.

F.1.1 acceptable cost level: the acceptable cost level for maintenance task.

F.1.2 adjust maintenance program (A4213): the activity which leads to changes in the maintenance program.

F.1.3 agree design (A122523, A122543): the activity which leads to agreement by corresponding organisations on a design.

F.1.4 agree final design (A25123, A25143): the activity which leads to agreement by corresponding organisations on a final design.

F.1.5 agree on auxiliary equipment detail specification (A122531): the activity which leads to agreement by corresponding organisations on a detailed specification of the auxiliary equipment.

F.1.6 agree on detail specification of deck machinery (A122552): the activity which leads to agreement by corresponding organisations on a detailed specification of the deck machinery.

F.1.7 agree on main engine detail specification (A122512): the activity which leads to agreement by corresponding organisations on a detailed specification of the main engine.

F.1.8 alarm: the signal (e.g. sound or light) automatically generated in case of danger or failure.

F.1.9 allocate material (A421414, A423114): the activity which leads to the allocation of material (equipment, raw material etc.) to a maintenance task.

F.1.10 allocate personnel (A421415, A423116): the activity which leads to the allocation of personnel to a maintenance task.

F.1.11 allocate/service tools and equipment (A421416, A423115): the activity which leads to the allocation of tools and equipment to a maintenance task.

F.1.12 allocated personnel: the shipyard personnel, assigned and scheduled to perform a specific maintenance task.

F.1.13 allowable limits: the acceptable limits for typical parameters of a specific system, component or part that should be met during maintenance inspection. Otherwise corrective action is required.

F.1.14 analyse failure (A42122): the activity of analysing the cause of failures.

F.1.15 approve auxiliary equipment design (A25132): the activity which leads to the design approval, by the corresponding organisations, of auxiliary equipment.

F.1.16 approve/certify maintenance (A42323): the activity which leads to the approval or certification of a maintenance task.

F.1.17 approve deck machinery design (A25152): the activity which leads to the design approval, by the corresponding organisations, of deck machinery.

F.1.18 approve design of ship machinery (A252): the activity which leads to the design approval, by the corresponding organisations, of ship machinery. The design approval relates to the machinery equipment and systems. The ship certification is not complete with this activity and would need equipment manufacturing surveys, tests and installation surveys as well.

F.1.19 approve main engine design (A25112): the activity which leads to the approval, by corresponding organisations, of the main engine.

F.1.20 approved design: the design which complies to the classification society's rules and has been approved by a classification society.

F.1.21 arrangements*: the arrangements of the ship are the ship's compartments and spaces. Any description of arrangements will include associated definitions of purpose for the compartment or space.

F.1.22 assemble ship (A33): the activity that assembles the modular units, the serviced parts and additional material that result from the production of steel sub-sections. The result is an assembled ship, that still has to be tested.

F.1.23 assemble ship/system (A423124): the activity of assembling a ship or its systems.

F.1.24 assemble steel sub-sections* (A331): the activity of assembling the ship steel sub-sections

F.1.25 assemble system (A421424): the activity of assembling the ship systems.

F.1.26 assembled ship*: the ship in its assembled form at the end of the construction phase. The assembled ship has to be tested and commissioned at subsequent activities.

F.1.27 assembling information: the data resulting from an assembly activity.

F.1.28 authorities: the organisations charged with ensuring the compliance to rules, regulations and standards.

F.1.29 auxiliary equipment: an equipment that supports one or more main systems or equipment.

F.1.30 availability, reliability and maintainability information: the information about the systems, equipment and components, needed for or resulting from availability, reliability and maintainability analysis.

F.1.31 available resources: the tools, test equipment, personnel etc. which a shipyard can allocate for maintenance purposes.

F.1.32 base material data: the data relating to spare parts, consumables and raw material which are available in shipyard base depots for maintenance purposes.

F.1.33 base personnel: the maintenance personnel at the base harbour.

F.1.34 base tools and equipment: tools and equipment available at the base or depot for maintenance purposes.

F.1.35 basic hull parameters*: estimated principal dimensions based on historical data.

F.1.36 bill of material*: the list specifying the parts and their materials which is used for ordering the required parts and material.

F.1.37 budget*: the cost constraint on the design, building and maintenance of the ship.

F.1.38 building specifications*: the information which specifies the detailed framework for the construction of the ship

F.1.39 calculate cost of ship* (A124): this activity describes creation of documents based on technical product data and their estimated manufacturing cost. The results of this activity may contain sale price documents, financing support plan and documents describing funding and possible loans.

F.1.40 calculate time/cost (A421413, A423113): the activity by which the duration and cost of a maintenance action are estimated.

F.1.41 calculated hours, schedule: calculated required man-hours, machine-hours and schedule needed to perform a specified maintenance action.

F.1.42 capacity: the available resources for maintenance purposes such as the number of available personnel.

F.1.43 carry out manoeuvring system analysis (A122542, A25142): the activity of completing various engineering analyses on the manoeuvring system as part of design and design approval processes.

F.1.44 carry out the ship survey (A434): the execution of a survey on a ship or its equipment.

F.1.45 carry out transmission system analysis (A122522, A25122): the activity of completing various engineering analyses on mechanical transmission systems as part of design and design approval processes.

F.1.46 certificates : the certificates issued by the classification society and flag state on completing the ship.

F.1.47 check boilers (A25222): the activity of checking the boiler specifications against the rules.

F.1.48 check deck machinery (A25225): the activity of checking the deck machinery specifications and design against the rules.

F.1.49 check design against rules and regulations (A2522): the activity by class society to ensure that equipment and machinery conform to rules and regulations.

F.1.50 check main engine (A25221): the activity of checking the specification and design of the main engine against the rules.

F.1.51 check manoeuvring system (A25223): the activity of checking the specification and design of the manoeuvring system against the rules.

F.1.52 check shafting and propeller (A25224): the activity of checking the specification and design of main shafts and propeller against the rules.

F.1.53 classification society: an independent third-party organisation within the marine industry with its own rules and regulations dealing with mainly safety aspects of the ship throughout its lifecycle.

F.1.54 collect information about local requirements for panels and elements* (A4323): the activity which leads to a list of requirements for panels and related elements.

F.1.55 collect information about safety arrangements* (A4324): the activity which leads to the specification of data relating to safety arrangements.

F.1.56 collect information about systems and components (A4322): the activity which leads to the specification of information relating to systems and components of a system.

F.1.57 collect owner's information on usage of tank* (A4326): the activity which leads to information relating to tank usage.

F.1.58 collect relevant data (A42121): the activity which leads to the collection of relevant data needed for diagnosis.

F.1.59 collect survey information about tank to be inspected* (A4321): the activity which leads to the specification of tank data required prior to tank inspection.

F.1.60 company objectives: the business objectives of a company relating to the use of maintenance data/information for future purposes.

F.1.61 compare values (A42112): the activity of comparing two values for fault diagnosis purposes.

F.1.62 complete and approve ship design (A2): the production of ship design documents and the classification drawings using the preliminary design from the bid preparation, as well as the required rules and regulations. The classification drawing may require several iterations with input and redmarking from the classification society.

F.1.63 complete design of outfitting and distribution systems* (A26): the selection of the necessary outfitting equipment. The selection is mainly based on former designs and in accordance with the requirements. It also contains the layout of the different types of distribution systems.

F.1.64 complete design of ship machinery (A25): the selection and arrangement of the ship equipment in terms of the main engine, associated propulsion system and its auxiliary machinery.

F.1.65 complete design of ship structure* (A24): the completion of the ship structural design.

F.1.66 components: the equipment or components which are part of the ship systems.

F.1.67 conclude (A42123): the activity of concluding a diagnostic investigation.

F.1.68 condition of class*: the maintenance condition of a ship from the classification society point of view. An unsatisfactory condition means that the ship no longer fulfils the classification requirements and maintenance deemed to be necessary.

F.1.69 conduct acceptance trials* (A344): the activity of sea trials that are performed with the owners and classification society to test the ship against the rules and regulations and the design. The output is the test result documentation.

F.1.70 conduct contractor sea trials* (A343): the activity of sea trials performed by the contractor to test the ship against rules and regulations and the design. The output is the test result documentation.

F.1.71 contract: the contract is the output from the activity which involves placing the order for the ship. The contract is used as a constraint in subsequent activities such as final design, approval and production.

F.1.72 corrective actions: the specification of activities needed to correct the status of a product.

F.1.73 corrective maintenance plan: the maintenance plan which specifies the corrective actions needed in order to maintain a failing system to its original specifications, fit for release for operation.

F.1.74 cost *: the calculated cost of the ship based on the cost of material and labour.

F.1.75 cost calculation data*: the information needed for performing a maintenance task cost analysis.

F.1.76 create preliminary blades (A1223133): the activity which leads to preliminary definition of propeller blades including blade overall size and geometric configuration.

F.1.77 create preliminary design (A122): all design activities relevant in a very preliminary stage of ship design in consideration of classification rules, national/international demands, shipyard constraints and owner requirements. The aim of this task is to make a shipyard offer.

F.1.78 create preliminary general arrangements* (A1222): the activity that produces the preliminary compartmentation plans from the preliminary hull form definition.

F.1.79 create preliminary hull form* (A1221): the activity that is the first step in designing a ship. Using parent ship's main dimensions and form parameters, one or more preliminary hull forms will be generated.

F.1.80 create preliminary machinery design (A1225): the activity that produces the preliminary designs for the ship machinery; including the prime mover, shaft system, fuel system, power systems and cargo handling equipment and so on.

F.1.81 create preliminary outfitting design* (A1226): the activity that produces the preliminary design for ship's outfitting including distributed systems such as piping and electrical systems.

F.1.82 create preliminary propeller arrangements (A1223132): the activity which leads to the definition of the preliminary propeller arrangements in relation to hull.

F.1.83 create preliminary propeller components (A1223134): the activity of deciding on the preliminary structure of a propeller in terms of its major components.

F.1.84 create preliminary structure design* (A1224): the activity that produces the preliminary steel structure design, including the arrangement of the primary structural members.

F.1.85 crew: the personnel onboard a ship.

F.1.86 crew staff: the ship crew members in charge of controlling and co-ordinating of shipboard activities (usually captain and officers).

F.1.87 critical design areas: the design areas at which a change may be expected, when performing a design approval preview

F.1.88 data from other sources: the data needed for performing the failure analysis which are not available from the normal on-board data sources such as logbook and maintenance manual.

F.1.89 decide post sales maintenance and support (A123): the activity that puts together the maintenance package for the ship. This is part of the tender document and includes the post sales support.

F.1.90 deck machinery: the machinery positioned on the main deck of the ship.

F.1.91 decommission and disassembly (A5): the activities that involve disassembly and preparing for reuse or recycling or disposal of machinery, parts, materials and so on.

F.1.92 define corrective actions (A42131): the activity which uses the diagnosis report and provides a list of actions needed to be undertaken as corrective maintenance.

F.1.93 define cost* (A42134): the activity which leads to the estimation of maintenance cost.

F.1.94 define resources (A42132): the activity which leads to a list of required resources needed for maintenance.

F.1.95 define time (A42133): the activity which leads to specification of time needed for maintenance.

F.1.96 deliver auxiliary equipment (A3333): the activity which leads to the delivery of the ship equipment to the shipyard.

F.1.97 deliver machinery (A3331): the activity which leads to the delivery of the ship machinery to the shipyard

F.1.98 delivery date: the date for delivery.

F.1.99 description of function: the description of the function that the component to be analysed shall perform.

F.1.100 design manoeuvring systems (A12254): the activities which lead to design of the manoeuvring system by the shipyard for the ship.

F.1.101 design modifications: the list of modifications made to the original design.

F.1.102 design transmission system (A12252): the activities which leads to design of the ship main mechanical transmission system.

F.1.103 detail survey planning (A4325): the activity which leads to a detailed plan for survey.

F.1.104 detailed instructions: the detailed procedure, resources needed and method of carrying out a maintenance activity.

F.1.105 detailed schedule: the detailed timetable for execution of maintenance actions together with a schedule of availability of tools and other resources.

F.1.106 detailed specification: the ship equipment and systems specifications as required for approval by the ship owner.

F.1.107 diagnose (A4212): the activity which leads to diagnosis of the reason for a failure.

F.1.108 diagnosis report: a document describing the conclusion of a failure analysis. It is the basis for preparation of a corrective maintenance plan.

F.1.109 disassemble ship/system (A423121): the process of disassembling of a ship or its systems.

F.1.110 disassemble system (A421421): the activity of disassembling a ship system.

F.1.111 distribution & outfitting design* : the design of the distribution systems (electrical and piping) and the outfitting.

F.1.112 equipment: a part of the engineering systems that carries out a generally self contained function and to a large extent can be treated as a single item for the purpose of design, acquisition or operation.

F.1.113 estimate hydrodynamics and powering (A1223): the activity that approximates hydrodynamic properties data calculations like resistance, propulsion, seakeeping and manoeuvrability for the preliminary hull form.

F.1.114 estimate hydrodynamics and powering* (A1223135): the activity which leads to hydrodynamic resistances of a ship and the power needed for ship propulsion.

F.1.115 estimate manoeuvrability* (A12233): the activity that deals with approximating the manoeuvrability of the ship and comparison of the results with design requirements. The proof of the ships manoeuvrability will principally be given in practice or by model testing. Measuring of rudder forces and rudder moments as well as of the radius of the turning circle during model tests will be done either in circulating water channels or manoeuvring basins.

F.1.116 estimate resistance and powering (A12231): the activity that includes the calculations based on historical data for producing powering and resistance data for the initial preliminary design.

F.1.117 estimate sea keeping* (A12232): the activity that calculates the theoretical behaviour of a vessel in a seaway. The solution of the coefficients of equations of motion may be obtained either by analytical or numerical methods. The natural periods of the ship will be calculated like the rolling, pitching and heaving motions.

F.1.118 evaluate maintenance (A4233): the activity which leads to evaluation of the whole of the maintenance activity on behalf of either shipyard or owner.

F.1.119 evaluate request & schedule bid* (A121): the activities of the shipyard when evaluating the inquiry of the ship owner for a new ship.

F.1.120 evaluation report: a document which contains the results of the maintenance evaluation activity and normally references the status, diagnosis, corrective action and maintenance reports.

F.1.121 execute maintenance (A42142, A42312): the activity which leads to execution and completion of a maintenance task.

F.1.122 experience*: applied expert knowledge.

F.1.123 failure analysis report: a document which describes the scope, analysis methodology and result of a failure analysis activity.

F.1.124 feedback: the feedback information.

F.1.125 finalise and approve general arrangements* (A21): the activity in which the design of a ship general arrangement is finalised as a detailed design.

F.1.126 finalise and approve hull form* (A22): the activity in which the hull form is finalised from the preliminary design done in the pre-contract stages. The result is a final and approved hull form design.

F.1.127 finalise and approve hydrodynamics and powering* (A23): this includes all relevant hydrodynamic calculations like resistance, propulsion, seakeeping and manoeuvrability.

F.1.128 finalise auxiliary equipment selection (A2513): the activity which leads to the selection and ordering of auxiliary equipment.

F.1.129 finalise deck machinery design (A2515): the activity which lead to the production of final design for deck machinery.

F.1.130 finalise machinery design (A251): the activities which leads to design of selected machinery such as the propeller which are in the scope of this part of ISO 10303.

F.1.131 finalise main engine selection (A2511): the activity which leads to the selection and ordering of the main engine.

F.1.132 finalise maintenance plan (A254): the activity which leads to preparation of a machinery maintenance plan.

F.1.133 finalise manoeuvring system design (A2514): the activity which leads to the design of the manoeuvring system.

F.1.134 finalise production planning* (A253): the activities which lead to a production plan.

F.1.135 finalise propeller design (A25122): the activity which leads to the final propeller design.

F.1.136 finalise selection of components (A25121, A25141): the activity which leads to the selection of various ship equipment.

F.1.137 finalise transmission system design (A2512): the activity which leads to the completion of the ship main mechanical transmission system design.

F.1.138 general arrangements*: the space arrangement plan from the preliminary or final design stage.

F.1.139 geometry, geography, technical documentation*: all documents, describing the ship, its systems and equipment.

F.1.140 historical data from previous designs: data held by the shipyard or model basin on previous ship designs and used to estimate the hydrodynamics, powering requirements and sea-keeping.

F.1.141 hull form sections*: The design of the hull moulded form at planar sections taken along the longitudinal axis of the ship.

F.1.142 hull moulded form*: the definition of the shape of the hull of the ship, resulting from the addition of the aft-body, mid-body and fore-body definitions, which does not take into account the thickness of the material from which the hull is made.

F.1.143 hydrodynamics & powering results* : the results of calculations and model basin tests. They contain resistance, propulsion, propeller performance, brake power, service speed, sea keeping and manoeuvrability data.

F.1.144 hydrostatic table*: the data which show the hydrostatic properties of the ship. They are a result of calculations at the initial and final design stages.

F.1.145 info parts to be repaired: the specific available information on the repair of parts, to be dispatched with parts for repair purposes.

F.1.146 info parts to be replaced: the specific information relating to replacement of parts.

F.1.147 info parts to be serviced: the specific information on the servicing of parts after disassembly of the ship/system.

F.1.148 information sub-assemblies: the information on steel sub-assemblies.

F.1.149 inspection information: the information resulting from previous inspection which may be used for maintenance and repair purposes.

F.1.150 inspect ship/system (A42322): the activity which leads to the inspection of a ship and its equipment.

F.1.151 install auxiliary equipment (A3334): the activity which leads to the installation of the auxiliary equipment.

F.1.152 install equipment (A333): the activity which leads to the installation of the equipment.

F.1.153 install machinery (A3332): the activity which leads to the installation of the machinery.

F.1.154 install modular build units* (A332): the activity which leads to the installation of modular build units.

F.1.155 install modular machinery systems* (A334): the activity which leads to the installation of modular machinery systems.

F.1.156 installed equipment: the ship equipment as-installed information.

F.1.157 integrate changes on auxiliary equipment design (A25131): the process of including design refinements in the auxiliary equipment design in order to generate the final design.

F.1.158 integrate changes on deck machinery design (A25151): the process of including design refinements in the deck machinery design in order to generate the final design.

F.1.159 integrate changes on main engine design (A25111): the process of including design refinements in the main engine design in order to generate the final design.

F.1.160 knowledge and experience: the previous experience and knowledge of companies involved throughout the ship lifecycle.

F.1.161 laws, rules and regulations : national laws, statutory regulations and classification society rules that are used to control the design, manufacture, operation, maintenance and scrapping of the ship.

F.1.162 list of items to be inspected: the list of ship items, provided by the classification society or any other authorities to the owner, which needs to be inspected.

F.1.163 list of required certificates*: as a result of placing an order, this is the list supplied by the ship owner for certificate requirements.

F.1.164 list of required personnel: the list of technical personnel, for carrying out the specific task, including numbers, training and skill (experience) information.

F.1.165 list of required resources: the list of required resources including required tools, equipment, material and personnel for completion of a task.

F.1.166 list of tools and equipment: the list of tools and equipment needed to carry out a task.

F.1.167 loading and stability manual*: the document which details loading and stability information for use by the ship operator.

F.1.168 loading conditions*: standard loading conditions, defining the quantities of cargo, ballast water and consumables such as fuel oil and lubrication oil, in each space or compartment, which is used as a basis for design.

F.1.169 logbook: the shipboard documentation, recording the main aspects of ship and equipment's operation characteristics, events etc. The logbook is updated daily.

F.1.170 machinery design: the design drawings and electronic models of the ship mechanical systems. An output from the final design process.

F.1.171 machinery systems: an engineering system comprising of reciprocating or rotating equipment with the primary function of providing mechanical power against a load.

F.1.172 main engine: the information required in order to select the main engine.

F.1.173 maintain a ship (A42): the activity of bringing up a ship to its acceptable sailing condition, normally after a failure or a predefined period of operation.

F.1.174 maintain at base (A422): the execution of the maintenance task at base (port).

F.1.175 maintain at yard (A423): the execution of the maintenance task at shipyard.

F.1.176 maintain on board (A421): the execution of the maintenance task on-board ship at sea.

F.1.177 maintenance history: the documented history of maintenance information, normally beginning with the commissioning phase of ship lifecycle.

F.1.178 maintenance personnel: the personnel or crew needed to perform the maintenance activity.

F.1.179 maintenance reports: documents (reports) which describe all aspects of a specific completed maintenance task including procedures used, equipment or system information, actions carried out and results.

F.1.180 make report (A421426, A423126): the activity which leads to the preparation of the task report.

F.1.181 manoeuvring system: a system used to perform planned movement or change from the straight steady course and speed of a ship.

F.1.182 manoeuvring system design: the design specification and drawings of the ship manoeuvring system.

F.1.183 manufacturing restrictions : a constraint on the ship construction and design processes governed by available technology and shipyard facilities.

F.1.184 material allocation/ordering*: the data describing the necessary material supply for production.

F.1.185 material and certificates*: the name and specification of materials and the required quality and quantity certificates.

F.1.186 material data*: the specification of material properties.

F.1.187 material list*: the list of raw materials needed to manufacture the ship. A result of the final design process.

F.1.188 measurement report: the document (report) containing the measured values of a parameter from an instrument, related to condition (status) of systems.

F.1.189 model basin consultants*: the organisations which perform model basin tests to calculate hydrodynamics and powering data.

F.1.190 model basin theory*: the theory, along with empirical data, used by the model basin consultants to calculate the hydrodynamics and powering information.

F.1.191 modifications from machinery: modifications due to changes to machinery.

F.1.192 modification to hull form*: modifications to the hull shape due to feedback from hydrodynamics and powering results and the final design process.

F.1.193 modular build units*: the modular assemblies of ship steel sub-sections, normally produced in the shipyard. These are later on assembled onto the ship.

F.1.194 modular machinery systems*: the modular assemblies of ship machinery systems, either assembled in or delivered to the shipyard. These are later on assembled onto the ship.

F.1.195 monitor status (A4211): the process of monitoring the status of equipment.

F.1.196 noise and vibration level: the equipment and system noise and vibration levels that influence the design of ship systems.

F.1.197 notify owner about items due to survey (A431): the activity by which the ship owner is informed of the items which need to be surveyed by the class society.

F.1.198 observe signal (A42111): the activity or process by which a specific signal or parameter is being monitored.

F.1.199 offer*: the result of the preliminary design process. It will contain the shipyard's data for producing the requested ship.

F.1.200 offer guidelines*: the offer guidelines include the data necessary to make an unconditional offer to the ship owner.

F.1.201 on-board material data: the data relating to spare parts and consumables for on-board maintenance.

F.1.202 on-board tools and equipment: the tools and testing equipment, on-board-ship, needed for maintenance.

F.1.203 operate and maintain a ship (A4): the activity that describes the running and maintenance of the ship during its service lifetime.

F.1.204 operate a ship (A41): the activity of keeping a ship in operation.

F.1.205 operational history: the operational historical data, normally recorded in the ship logbook.

F.1.206 operational information: accumulated information during the operation phase of the ship used for maintenance and in the final scrapping stage.

F.1.207 operation manual: the document (manual) describing how an equipment or system should be operated.

F.1.208 owner : the organisation which requests, orders and takes delivery of the ship.

F.1.209 owner request, requirements : the requirements document that is submitted to the shipyard by the owner upon the invitation to tender.

F.1.210 perform design approval (A2521): the activity which is mainly carried out by the classification society in approving the design of certain equipment and systems.

F.1.211 perform maintenance (A4214, A4231): the activity of carrying out a maintenance task.

F.1.212 perform ship lifecycle (A0): all of the lifecycle activities associated with a ship.

F.1.213 place order* (A13): the owner places an order for a ship from the bids that have been submitted. From this a contract is awarded.

F.1.214 planned maintenance system: a software system relying on the data created during the final design process and used during the operation and maintenance of the ship.

F.1.215 power requirements for engine: the engine power resulting from the hydrodynamics and powering calculations which is used in the selection of the main engine.

F.1.216 pre-layout*: the very initial layout of the ship which is produced during the bid evaluation stage and is the basis for the preliminary design.

F.1.217 predict brake power and service speed* (A122314): the activity that estimates the required propulsive power and speed in order to be able to choose the correct size of main engine and propeller.

F.1.218 predict propeller performance (A122313): the activity that uses propulsion data to produce an initial propeller functional design.

F.1.219 predict propulsion data* (A122312): an activity that estimates propulsion data including propulsive power and other data, such as propulsive coefficient, propeller coefficient, hull efficiency, relative rotative efficiency, thrust deduction fraction and wake fraction.

F.1.220 predict resistance* (A122311): the activity that predicts the ship resistance. The resistance calculation will be done using historical data related to the geometry of the ship.

F.1.221 preliminary design : the preliminary ship design, which is completed in the phases leading up to the submittance of the tender.

F.1.222 preliminary hull form*: the definition of the hull form, as a result of the preliminary design process. Used in the offer documents and for preliminary hydrodynamics and powering calculations.

F.1.223 preliminary machinery design: the overall specifications of the ship mechanical systems, resulting from the preliminary design process. Used in the offer document and for preliminary compartment design, hydrodynamics and powering calculations.

F.1.224 preparation report: a document.

F.1.225 prepare bid (A12): all activities of the shipyard regarding preparation and submission of the offer to the ship owner for the ship to be built.

F.1.226 prepare for maintenance at base/yard (A4215): all activities relating to the preparation of the ship or its equipment/systems for a maintenance task to be carried out at the base harbour/shipyard.

F.1.227 prepare maintenance (A42141, A42311): all activities relating to the preparation of the ship or its equipment/systems for a maintenance task.

F.1.228 prepare ship for survey (A433): all activities relating to the preparation of a ship or its equipment/systems for survey.

F.1.229 present offer* (A125): the activity concerned with presentation of the offer to the ship owner for building a new ship.

F.1.230 preventive maintenance procedures: the document describing the procedures for preventive maintenance.

F.1.231 previous design*: an existing ship design, that is used as the basis for a new ship design.

F.1.232 produce and approve reference documents* (A35): the activity of creating the technical documentation for the ship, using production information. The output includes the loading and stability manual.

F.1.233 produce and inspect ship (A3): the activity that describes how the design is transformed into a real product. In the production phase the design has to prove its produceability. The production is controlled by the schedule, the approved design, the contract and any manufacturing restrictions. The result of the activity is the completed ship and technical documentation and certificates.

F.1.234 produce modular build units* (A32): the activity which leads to the production of the modular units which will make up the completed ship. They are produced from the steel sub-sections and their production is controlled by the schedule, contract, the approved design, and any manufacturing restrictions. The results of the activity are the modular units which are assembled into the ship.

F.1.235 produce steel sub-sections* (A31): the activity which leads to the production of the steel sub-sections which make up the structure of the completed ship. This is controlled by the schedule, contract, the approved design, and any manufacturing restrictions.

F.1.236 product component information: the technical data of the components that will be incorporated into the ship. These are taken into consideration when the preliminary designs are being made.

F.1.237 production information*: information describing a product, e.g. dimensions, mechanical properties, workshop information.

F.1.238 product model data: information describing a product. In this case, all the information about the ship over its lifecycle belongs to the product model data.

F.1.239 propeller design: the design of the propeller or propulsor as a result of the hydrodynamics and powering calculations. The design controls some of the machinery design activity.

F.1.240 propeller functional design: the functional design data of the propeller.

F.1.241 propeller theory: the body of knowledge based on the historical experience and abstract ideas of ship propeller performance.

F.1.242 proposed designs*: the output from the preliminary design stage that includes the best short list of ship designs that satisfies the proposed owner's requirements.

F.1.243 qualification requirements: the required qualification of the personnel to be allocated to a task

F.1.244 quality assurance*: an organisation within the shipyard that has the task to audit the shipyard organisation and applied processes in a manner such that the quality of the resulting product is assured.

F.1.245 refined design for classification: the new design which would require the approval of the classification society.

F.1.246 regular wave theory *: the body of knowledge which relates the motion response of a ship in waves of constant height and period.

F.1.247 release for operation (A4232): the process of releasing a ship for operation.

F.1.248 relevant data: the data needed for carrying out a specific task.

F.1.249 repair information: the information about the repair task including procedures, resource data and organisation responsible.

F.1.250 repair parts (A421423, A423123): the activity which leads to the maintenance of parts.

F.1.251 request a ship* (A11): the first activities of a ship owner when intending to order a ship. Having definite ideas regarding appearance and functionality of the ship, the owner expresses these ideas in an inquiry to the shipyard.

F.1.252 request for additional data: a request for extra information to enable the completion of a task.

F.1.253 request for changes*: changes that are requested to the ship design as a result of production experience or difficulties with the realisation of the ship design.

F.1.254 request for other level maintenance: the request for maintenance on another level as a result of a diagnosis activity.

F.1.255 request to change corrective actions: the request for changing the corrective actions for reasons that there are strong concerns about the feasibility of the planned actions.

F.1.256 request to change corrective maintenance plan: the request for changing the corrective maintenance plan for stated reasons.

F.1.257 request to change working plan: the request for changing the applicable working plan for reasons stated in the request.

F.1.258 resistance and powering results: the results for the resistance and powering of the ship determined from model tests.

F.1.259 resistance and shaft power: the ship resistance and required propulsive power.

F.1.260 resistance theory*: the theory used to predict the resistance of the hull to forward motion in the sea.

F.1.261 resource allocation*: the result of the capacity planning.

F.1.262 resources: shipyard, classification society and consultants.

F.1.263 results of zigzag, initial turning etc.* : the manoeuvring test results as from model basin tests or sea trials.

F.1.264 review maintenance report (A42321): the activity which analyses the maintenance report.

F.1.265 reviewed maintenance report: the document (maintenance report) which has undergone full review.

F.1.266 scantling requirements for plates stiffeners and other strength elements for all the panels, surrounding this tank*: the dimension of stiffeners and other strength elements.

F.1.267 schedule: the time table for a task.

F.1.268 schedule (A421411, A423111): the preparation of the time table for a task.

F.1.269 scrapping plan: the document which provides the schedule and resources required to dismantle the ship.

F.1.270 select auxiliary equipment (A12253): the activities which lead to the selection of auxiliary equipment.

F.1.271 select components (A122521, A122541): the activity which leads to the selection of ship equipment.

F.1.272 select deck machinery (A12255): the activity which leads to the selection of deck machinery.

F.1.273 select main engine (A12251): the activities which lead to the selection of the main engine by the shipyard.

F.1.274 service information: the information/data about the service activities.

F.1.275 service load required draughts etc.*: information about the service activities of the ship.

F.1.276 service parts (A421422, A423122): the activity of testing, upgrading and changing parts within a survey or maintenance activity.

F.1.277 ship : a large waterborne vessel whose design, manufacture and lifecycle operation is governed by the principles of naval architecture and in accordance with international and classification society regulations.

F.1.278 ship product data: the data describing the ship as a product.

F.1.279 ship weight modifications*: modification to ship weight due to the preliminary structure design.

F.1.280 shipyard: an organisation that designs and builds, maintains or repairs ships.

F.1.281 shipyard and classification society: the shipyard and classification society organisations.

F.1.282 shipyard and consultants: the resources of the shipyard which builds the ship and consultants who provide assistance in design.

F.1.283 shipyard (experts and tools): the shipyard's experts and software tools are the means by which the ship design is carried out.

F.1.284 short and long term responses* : the results of estimation of sea keeping ability that take into account both short term journeys in local seas and long term world wide journeys.

F.1.285 signal: any indicative thing such as measured values by meters, a visual impression etc.

F.1.286 specify and select auxiliary equipment (A122532): all activities associated with defining the specification of auxiliary equipment and its selection.

F.1.287 specify and select deck machinery (A122551): all activities associated with defining the specification of deck machinery and its selection.

F.1.288 specify and select main engine (A122511): all activities associated with defining the specification of the main engine and its selection.

F.1.289 specify initial propeller characteristics (A1223131): the activity which leads to the definition of overall propeller characteristics.

F.1.290 specify ship (A1) : all activities associated with the production of a detailed specification of the ship prior to a contract being placed.

F.1.291 speed : the design speed of the ship, as specified by the owner in the contract.

F.1.292 status report: a document (report) detailing the status of an equipment or system. The status report results from condition monitoring.

F.1.293 steel sub-sections: the sub-sections of the steel structure which are outfitted with the machinery and distribution systems before assembly.

F.1.294 structural design* : the design of the hull structure including hull, bulkheads, decks and stiffeners.

F.1.295 structure*: the steel structure of the ship including hull, bulkheads, decks and stiffeners.

F.1.296 sub-sections*: the steel sub-sections of a ship structure.

F.1.297 suppliers: the organisations which supply equipment to shipyard and ship owner.

F.1.298 support : all the organisations and personnel who contribute to the lifecycle of the ship.

F.1.299 survey a ship (A43): the activity which leads to the survey of a ship or its equipment.

F.1.300 survey plan: a document outlining the details of a survey plan with information such as critical areas, corrosion, risk schema, name of components/systems to be inspected.

F.1.301 survey planning (A432): the activity which leads to preparation of a survey plan.

F.1.302 survey report: the document (report) stating the results and details of a survey activity.

F.1.303 survey status: the data specifying the current status of a ship with regard to survey.

F.1.304 tank usage documentation: a document specifying the usage of a tank.

F.1.305 technical documentation: the documents which provide technical description for performing preventive maintenance.

F.1.306 technical documentation inspection report: a document.

F.1.307 technical requirements* : the detailed ship specification issued by the owner on the award of a contract to build a ship.

F.1.308 test (A421425, A423125): the activity of testing a part, a component, equipment or a system to its performance according to the specification.

F.1.309 test results: the maintenance test results are the results of functional tests carried out after the execution of maintenance tasks.

F.1.310 test ship (A34): this activity tests the actual ship against the design, contract and rules and regulations. The structure is tested and sea trials including testing of machinery are carried out. The test results are an output from this activity.

F.1.311 test structures* (A341): the steel structures are tested against rules and regulations and the design. The output is the test result documentation.

F.1.312 test systems (A342): the ship's systems including outfitting, machinery and mission systems are tested against rules and regulations and the design. The output is the test result documentation.

F.1.313 time/cost criteria: the shipyard criteria for calculating cost and time of a task (e.g. maintenance).

F.1.314 time/cost overview: estimated cost/time needed for carrying out a task.

F.1.315 tools and equipment ready for use: the details of available tools and equipment for maintenance.

F.1.316 tools and equipment requirements: the details of required tools and equipment for maintenance.

F.1.317 total resistance*: the resistance of the hull due to motion in the water.

F.1.318 transmission system: a system by which motive power from a prime mover is made available at load and matched to load (e.g. shafting system connecting main engine to propeller, or shafting system connecting auxiliary engine to generator).

F.1.319 transmission system design: the definition of the transmission system design. Includes all the information, normally in drawing form, including those of the selected equipment.

F.1.320 transportation needs: a constraint which determines the specification for ship constructions.

F.1.321 update logbook (A42324): the activity of recording new operational data in the ship logbook.

F.1.322 update maintenance history (A42325): the activity of recording new maintenance data in the ship maintenance history document.

F.1.323 updated logbook: the logbook resulting from the inclusion of new operational data.

F.1.324 updated maintenance history: the maintenance history document resulting from inclusion of new maintenance data.

F.1.325 updated survey status: the status report resulting from inclusion of new survey data.

F.1.326 validate initial propeller (A1223136): the activity of validating the initial propeller design for satisfying the hydrodynamic and powering requirements of the ship.

F.1.327 weights and compartmentation*: the ship arrangement and weight details.

F.1.328 weights distribution*: the details of the weight distribution taking account of steel weight, machinery weights and cargo and the associated floating position of the ship.

F.1.329 work calculation data*: the data such as labour rates, depreciation rates, operating costs etc. needed for calculation of financial estimates.

F.1.330 work load*: the total effort required to build the chosen ship design as estimated by the shipyard and its consultants.

F.1.331 write/select instructions (A421412, A423112): the process of selecting the instructions needed for carrying out a task.

F.1.332 yard: an organisation that designs and builds, maintains or repairs ships.

F.1.333 yard facilities: all the equipment, tools, infrastructure, personnel etc. of a shipyard used for ship production.

F.1.334 yard material data*: the data relating to available, equipment, tools, components, parts and raw material in a shipyard.

F.1.335 yard personnel*: the technical personnel of a shipyard.

F.1.336 yard staff*: the staff of a shipyard.

F.1.337 yard tools and equipment*: the tools and equipment of a shipyard.

F.2 Application activity model diagrams

The application activity diagrams are given in Figures F.1 to F.44. The graphical form of the application activity model is presented in the IDEF0 activity modelling format. Activities and data flows that are out of the scope of this part of ISO 10303 are marked with asterisks.

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			X			Top

transportation need

laws, rules and regulations

manufacturing restrictions

perform ship life cycle

A0

knowledge and experience

historical data from previous designs

feedback

ship product data

resources (shipyard, classification society, consultants)

NODE: A-0	TITLE: SHIP LIFE CYCLE DESCRIPTION	NUMBER: 1
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Figure F.1 – Node A-0: ship life cycle description

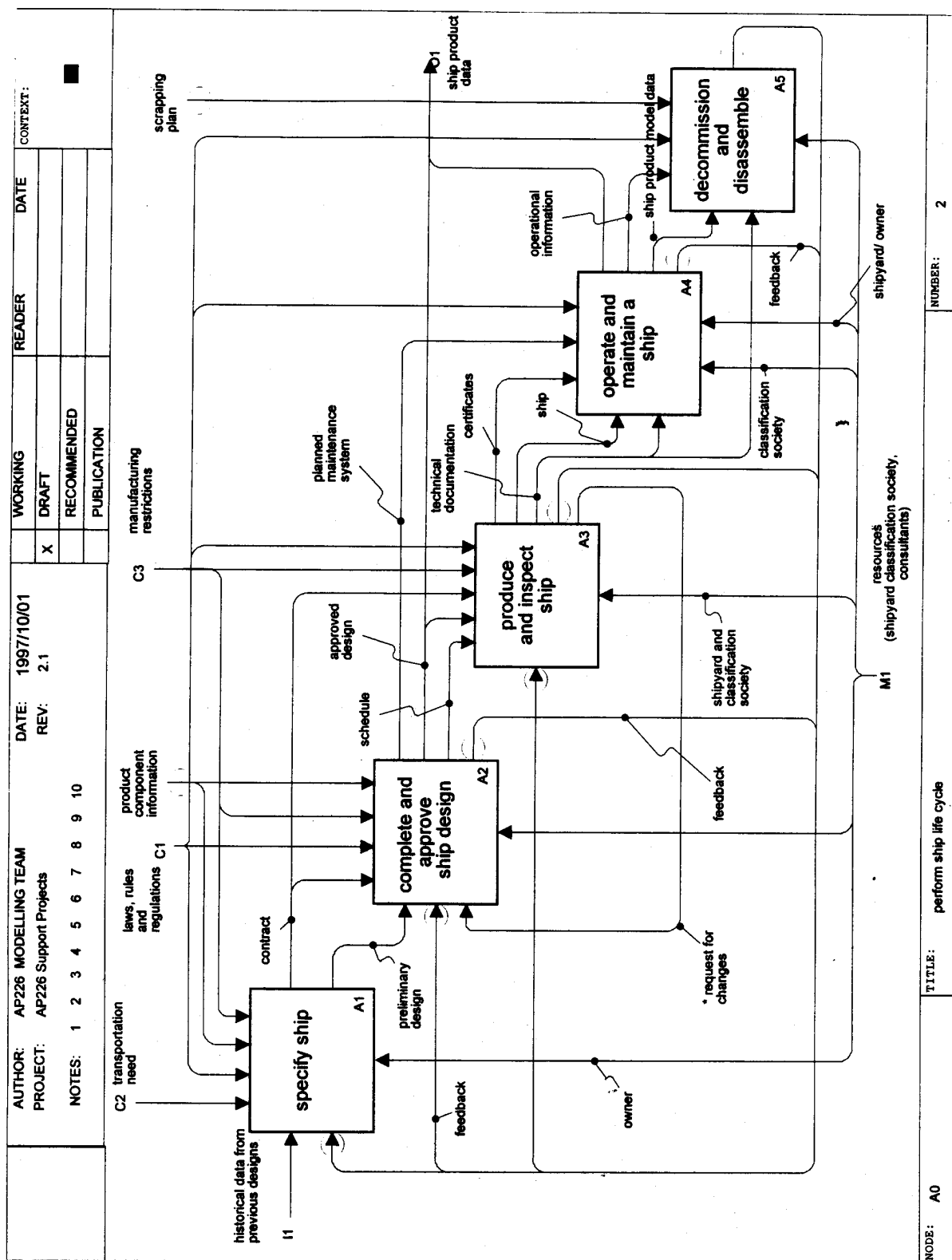


Figure F.2 – Node A0: perform ship life cycle

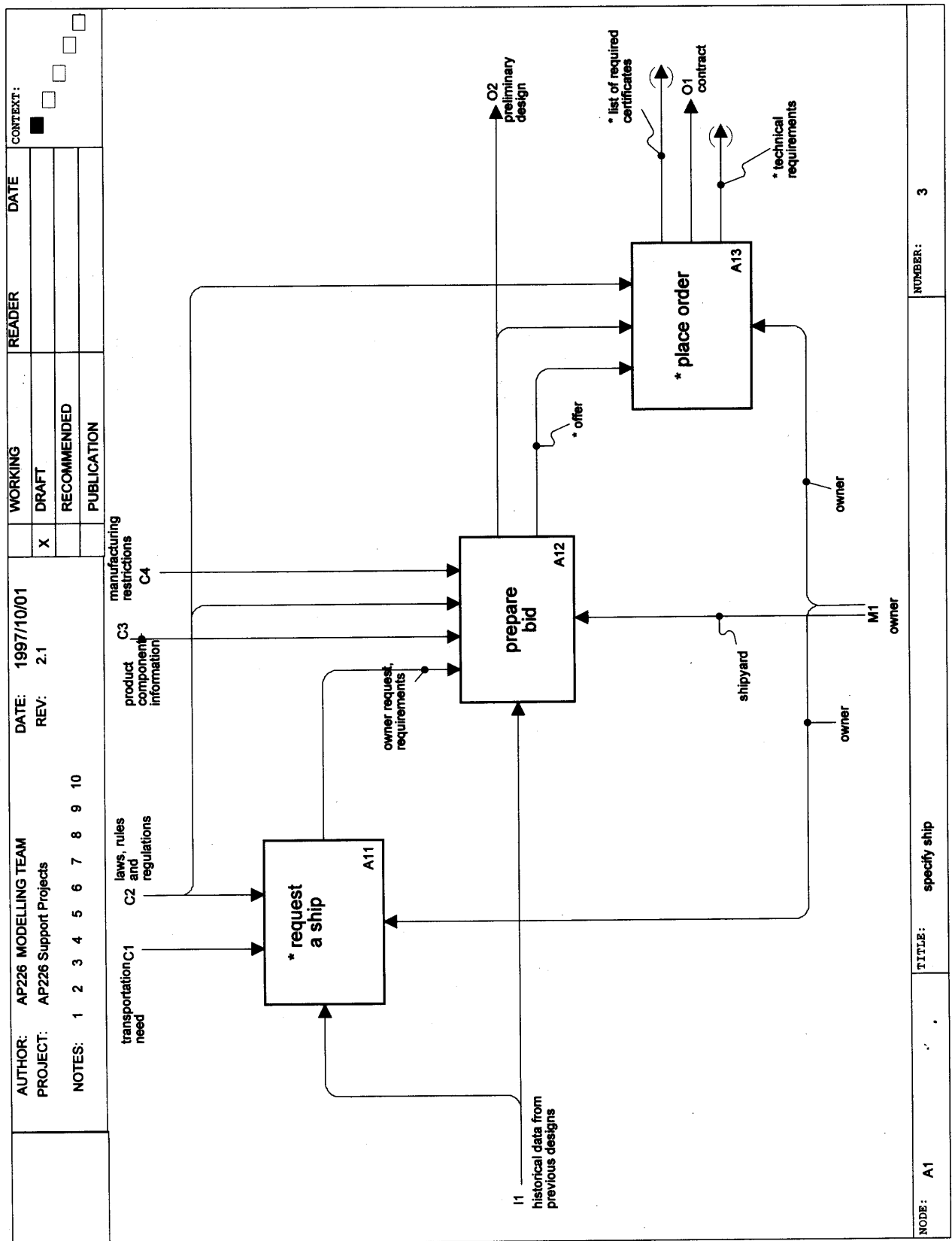


Figure F.3 – Node A1: specify ship

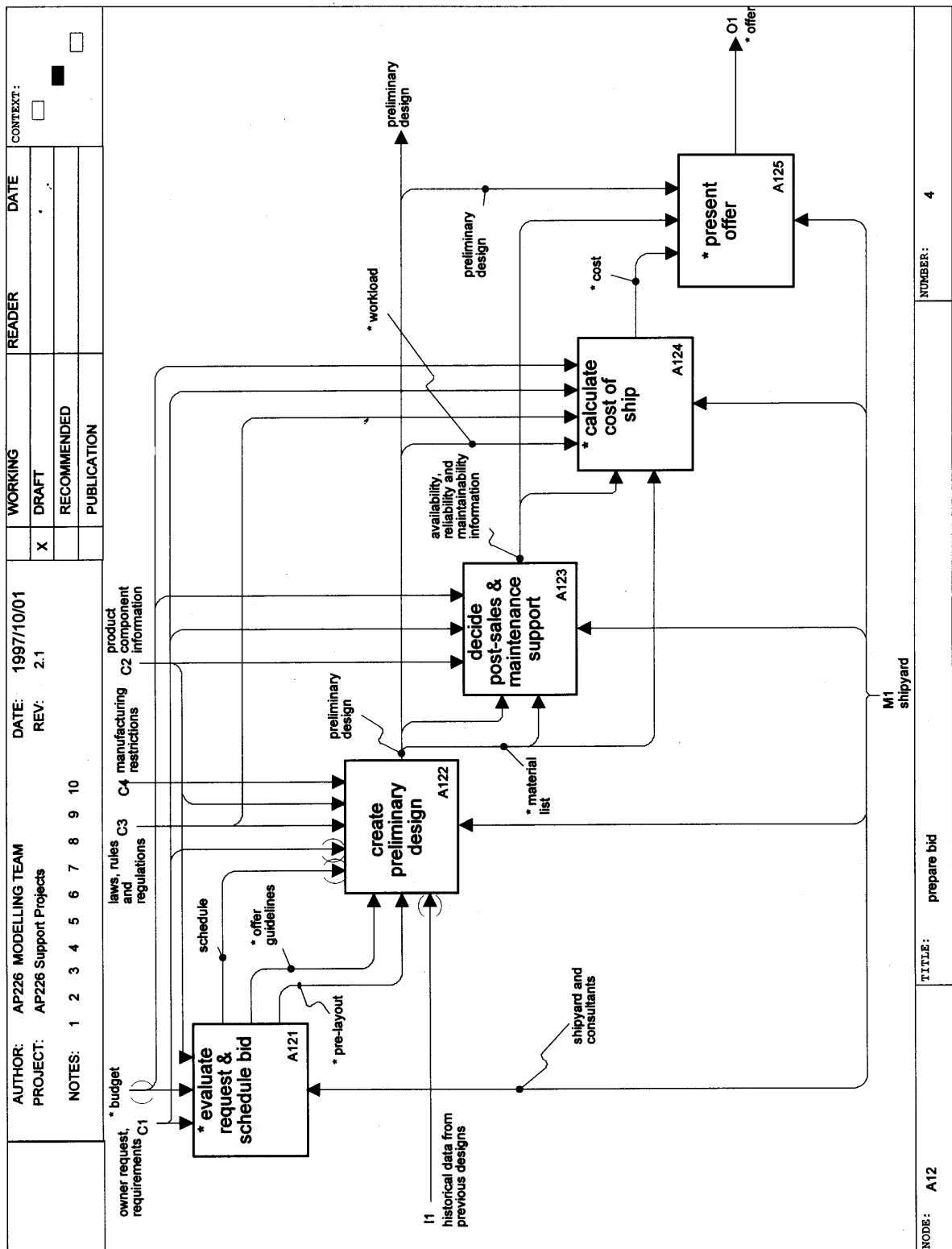


Figure F.4 – Node A12: prepare bid

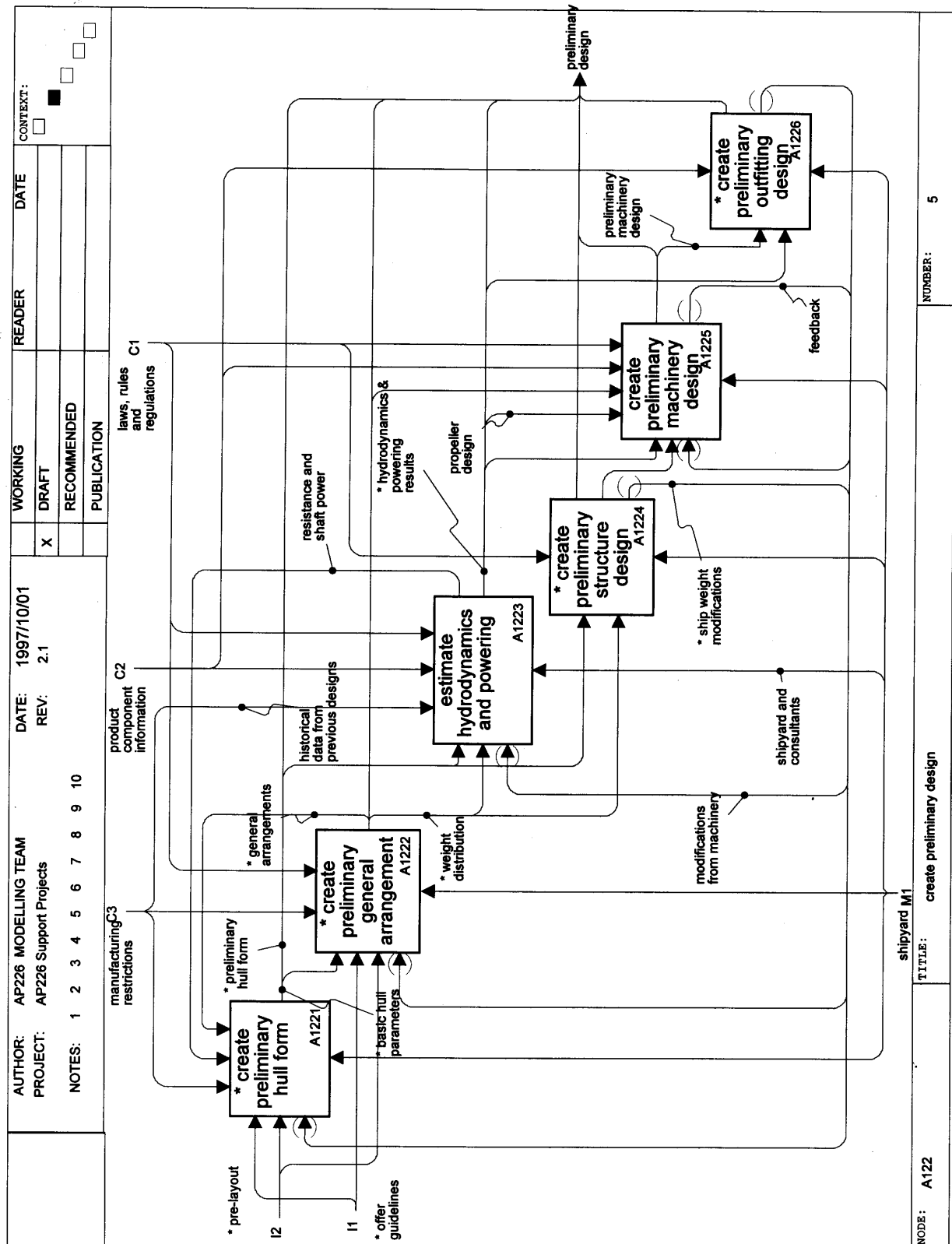


Figure F.5 – Node A122: create preliminary design

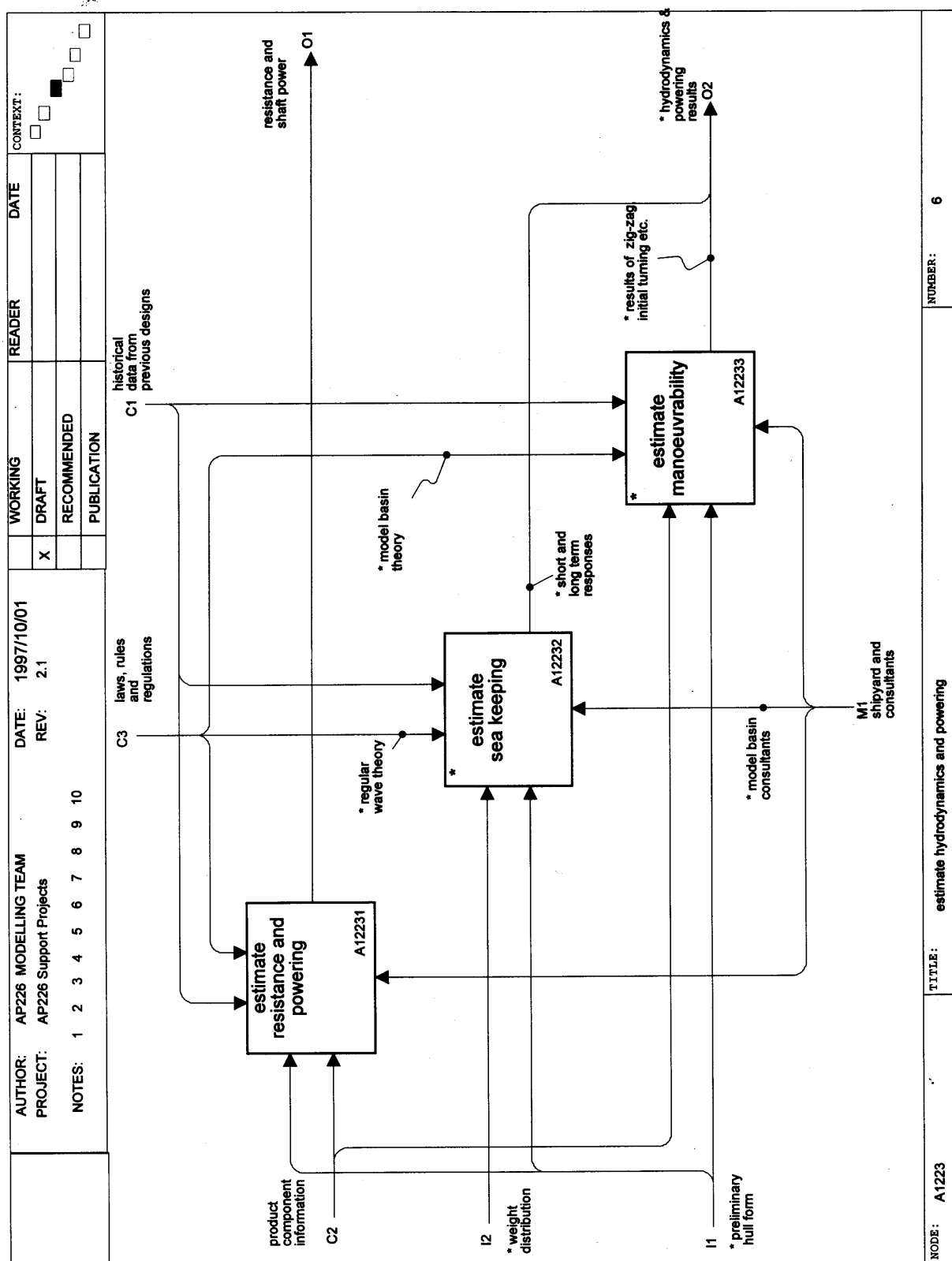


Figure F.6 – Node A1223: estimate hydrodynamics and powering

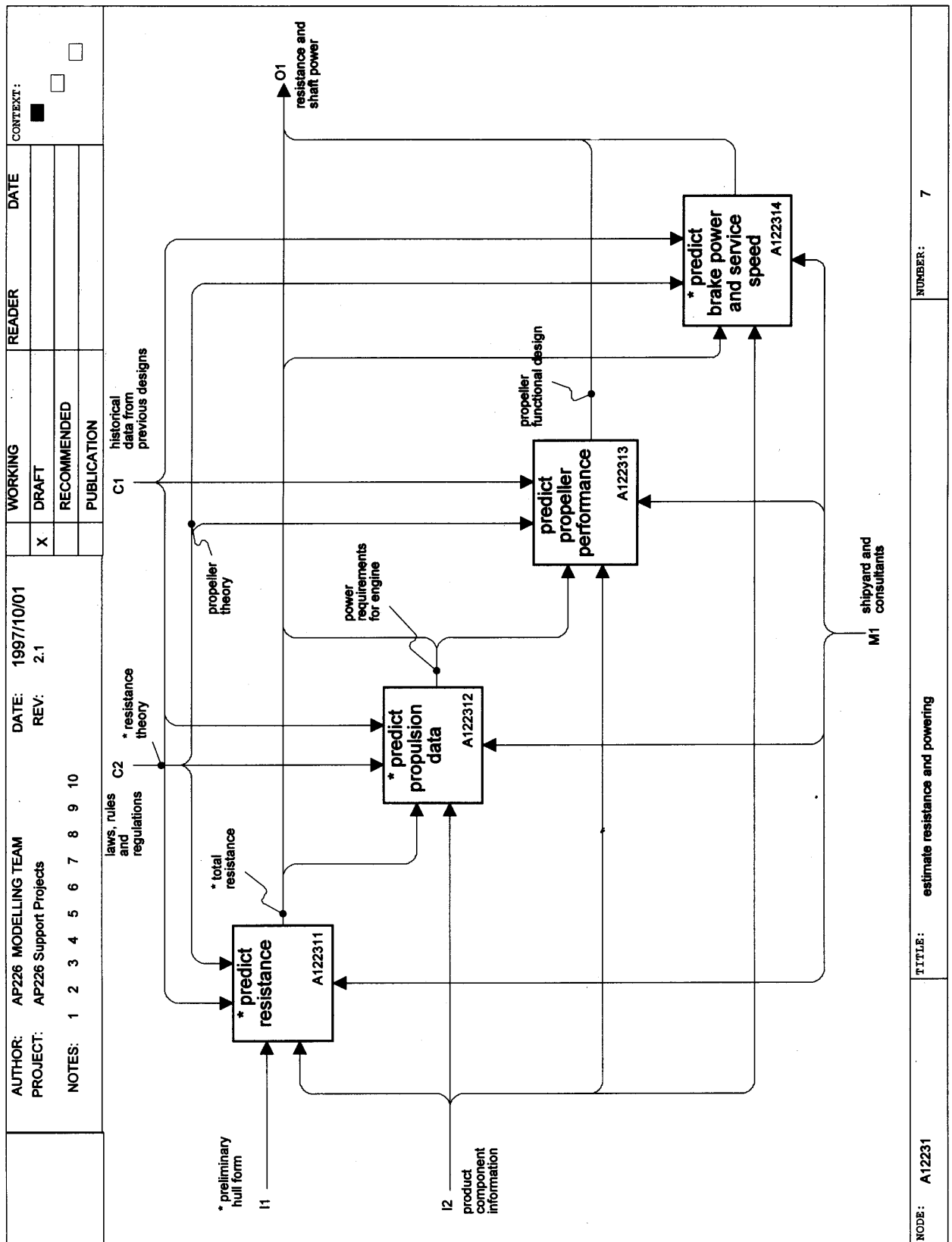
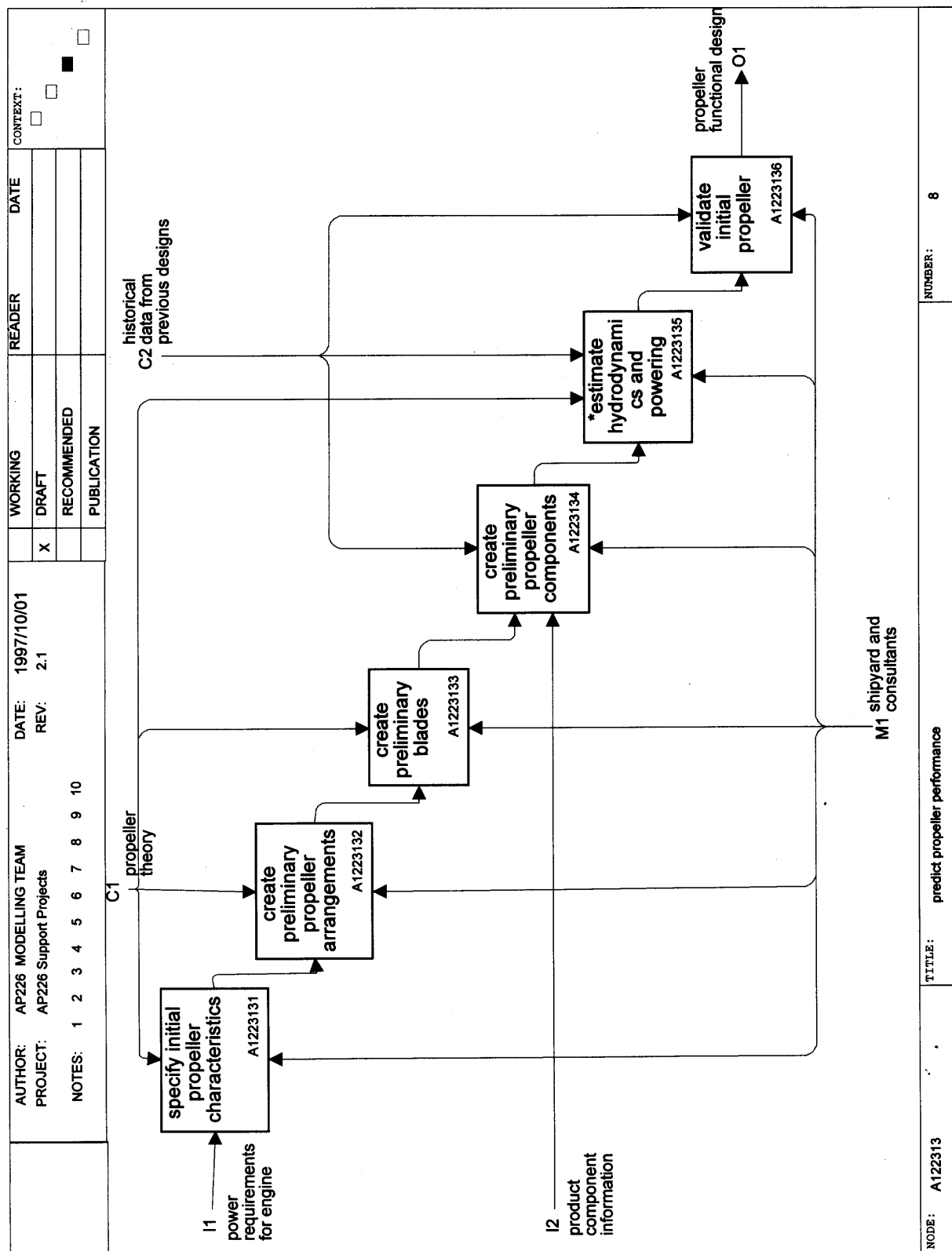


Figure F.7 – Node A12231: estimate resistance and powering



NUMBER: 8

TITLE: predict propeller performance

NODE: A122313

Figure F.8 – Node A122313: predict propeller performance

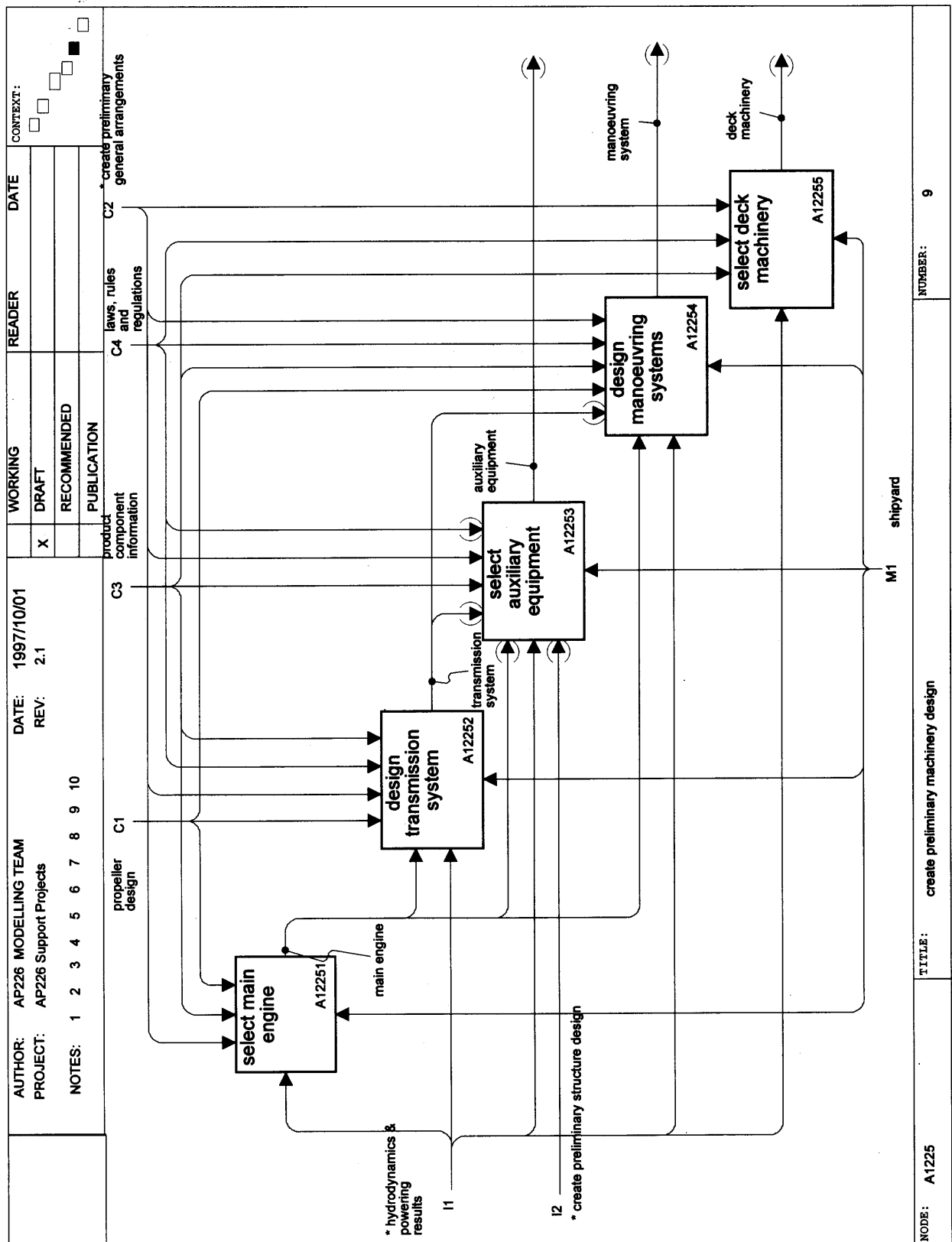


Figure F.9 – Node A1225: create preliminary machinery design

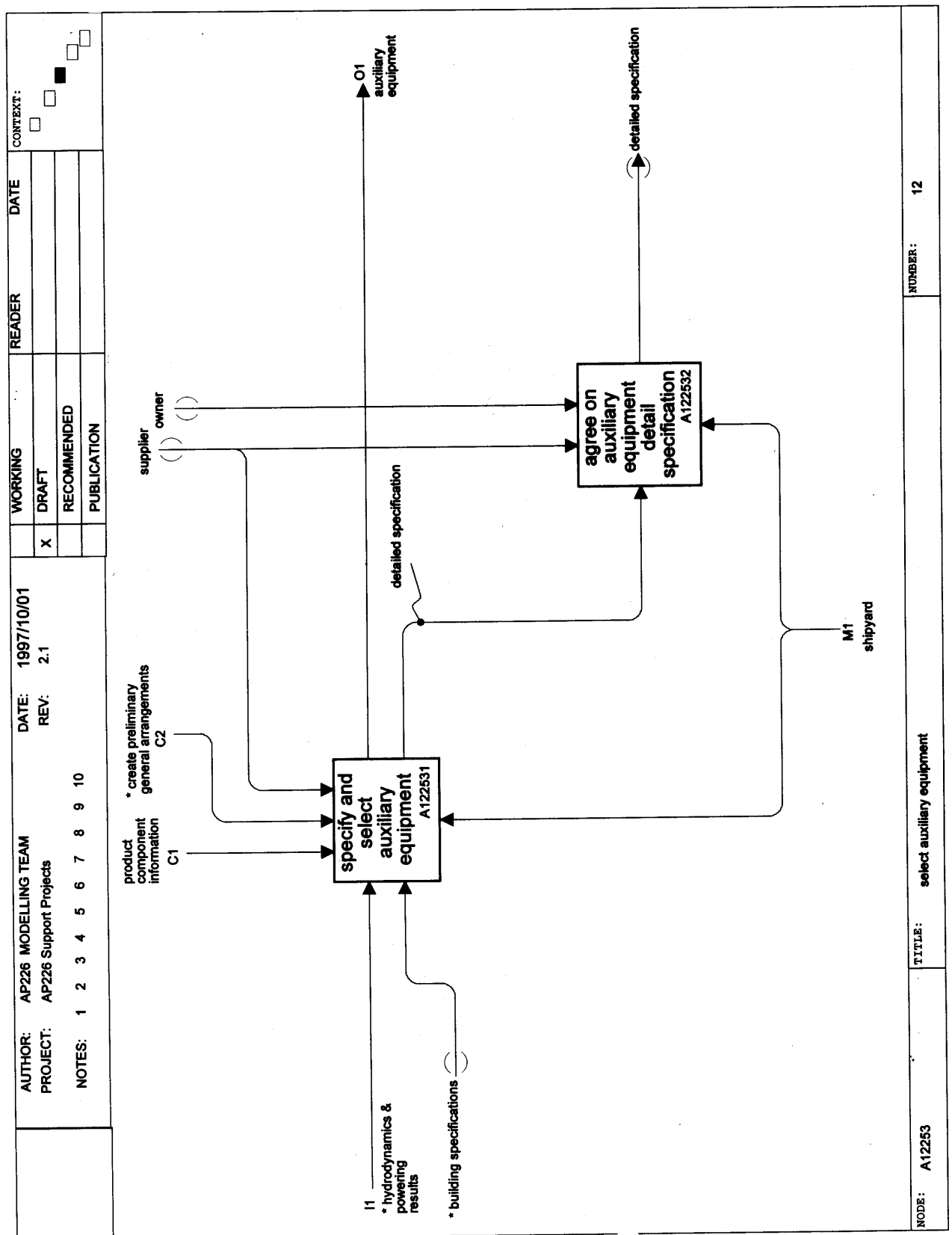


Figure F.10 – Node A12251: select main engine

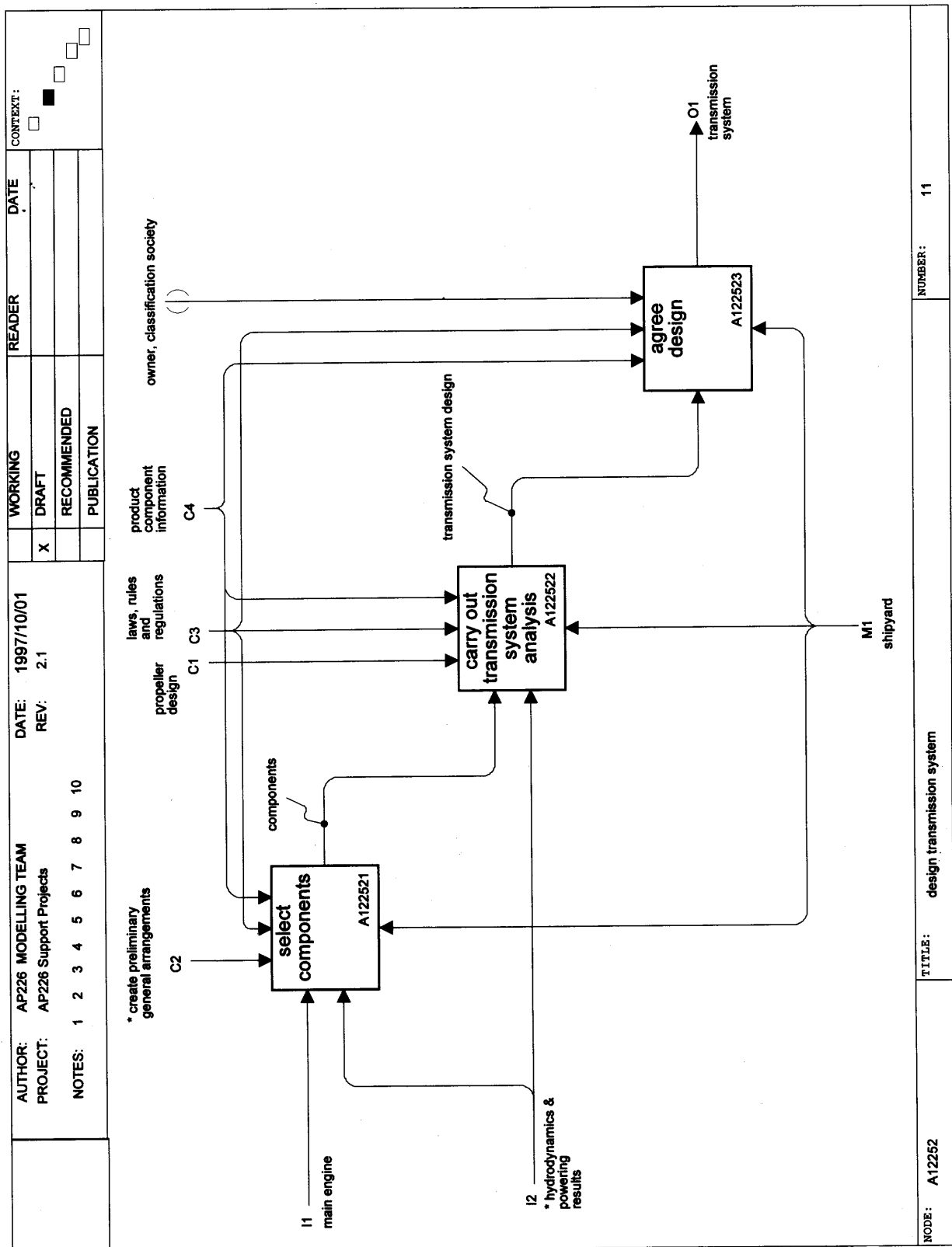


Figure F.11 – Node A12252: design transmission system

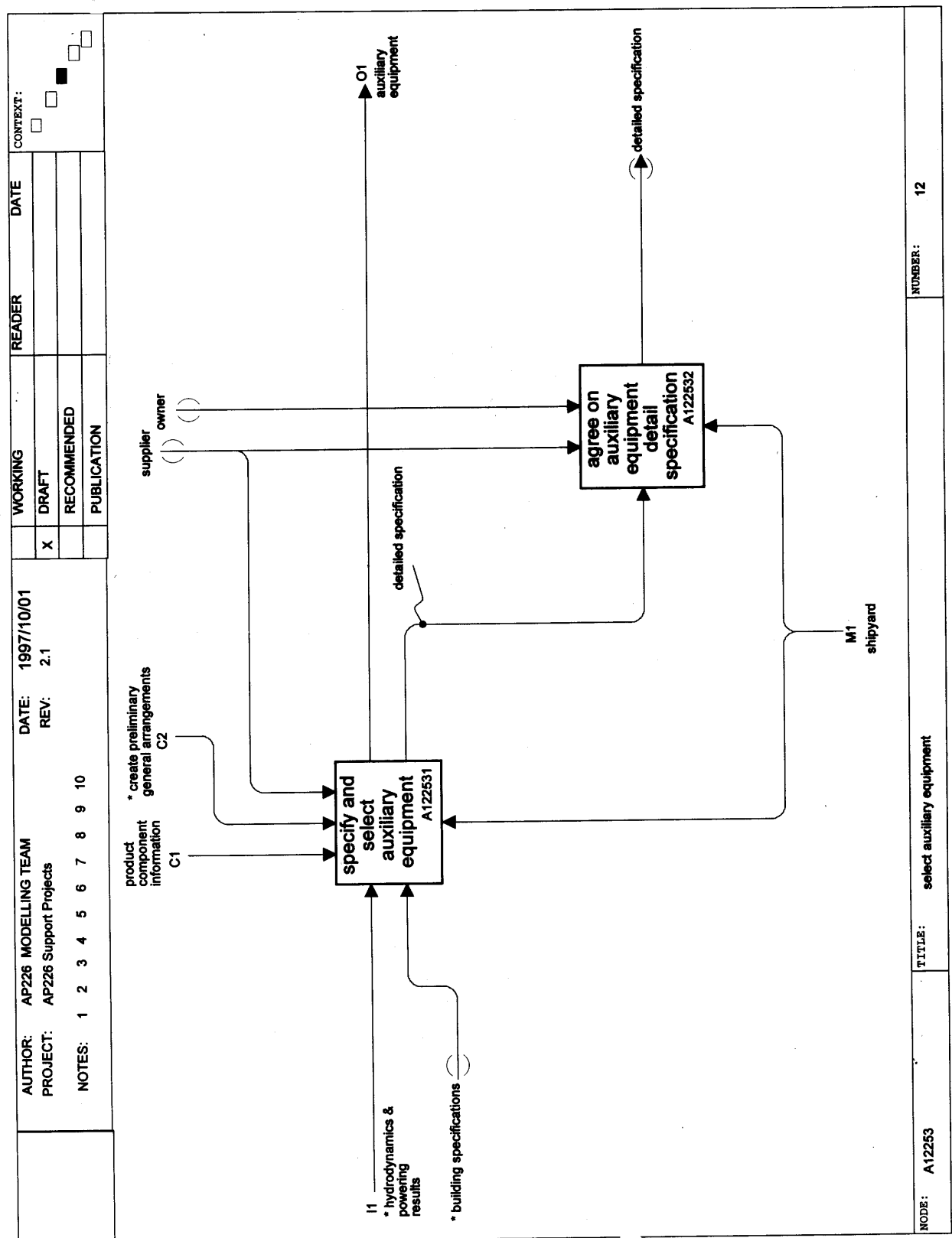


Figure F.12 – Node A12253: select auxiliary equipment

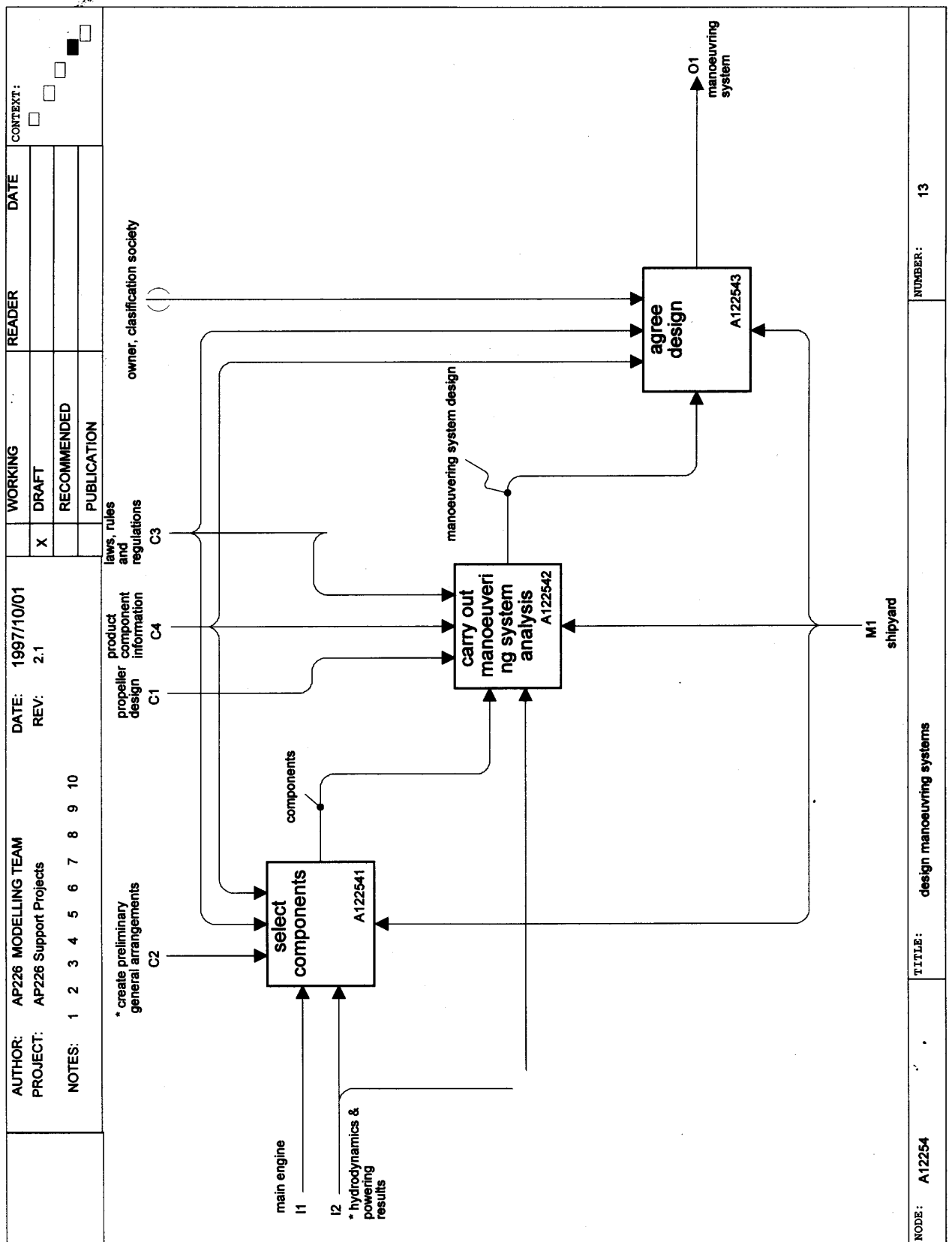


Figure F.13 – Node A12254: design manoeuvring systems

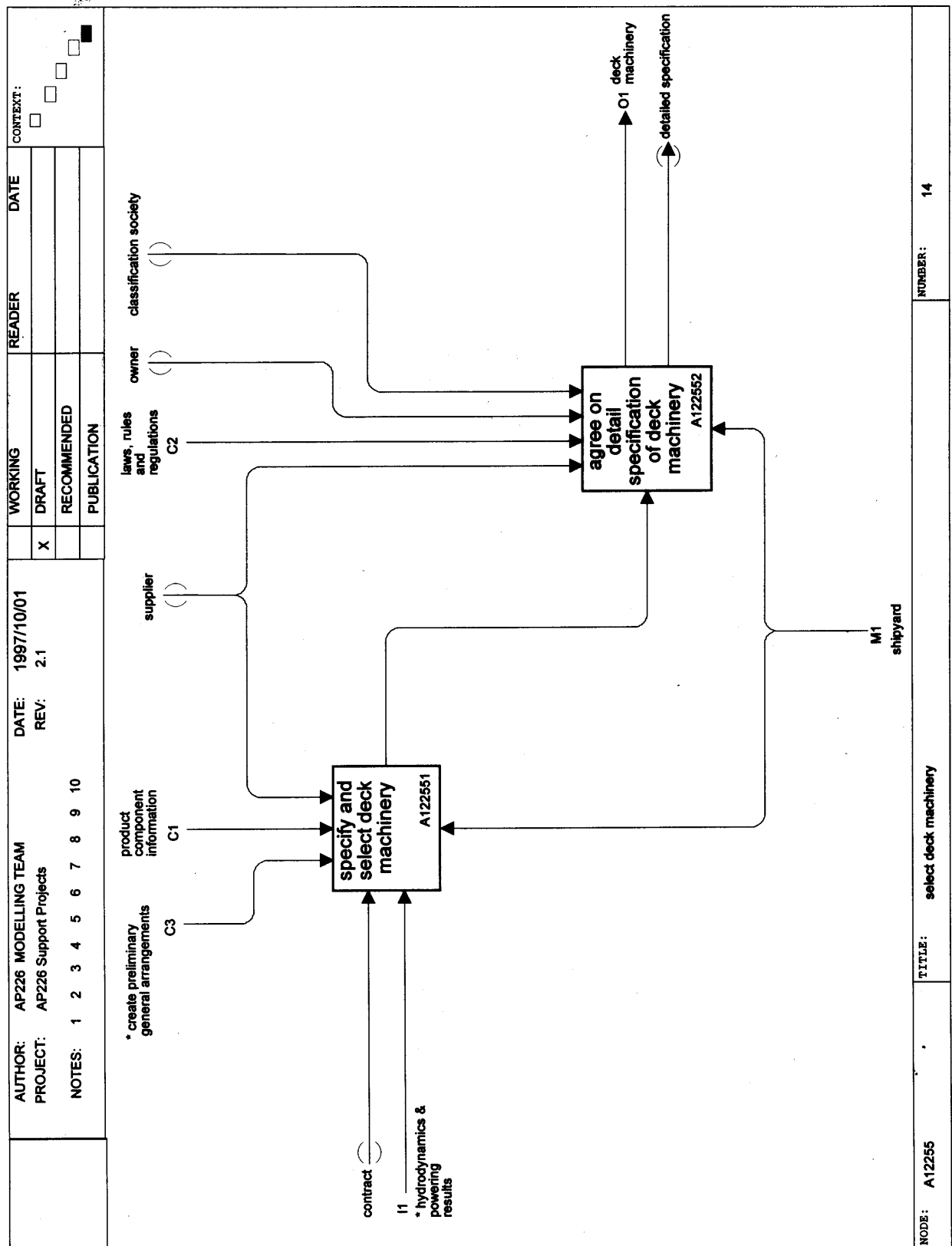


Figure F.14 – Node A12255: select deck machinery

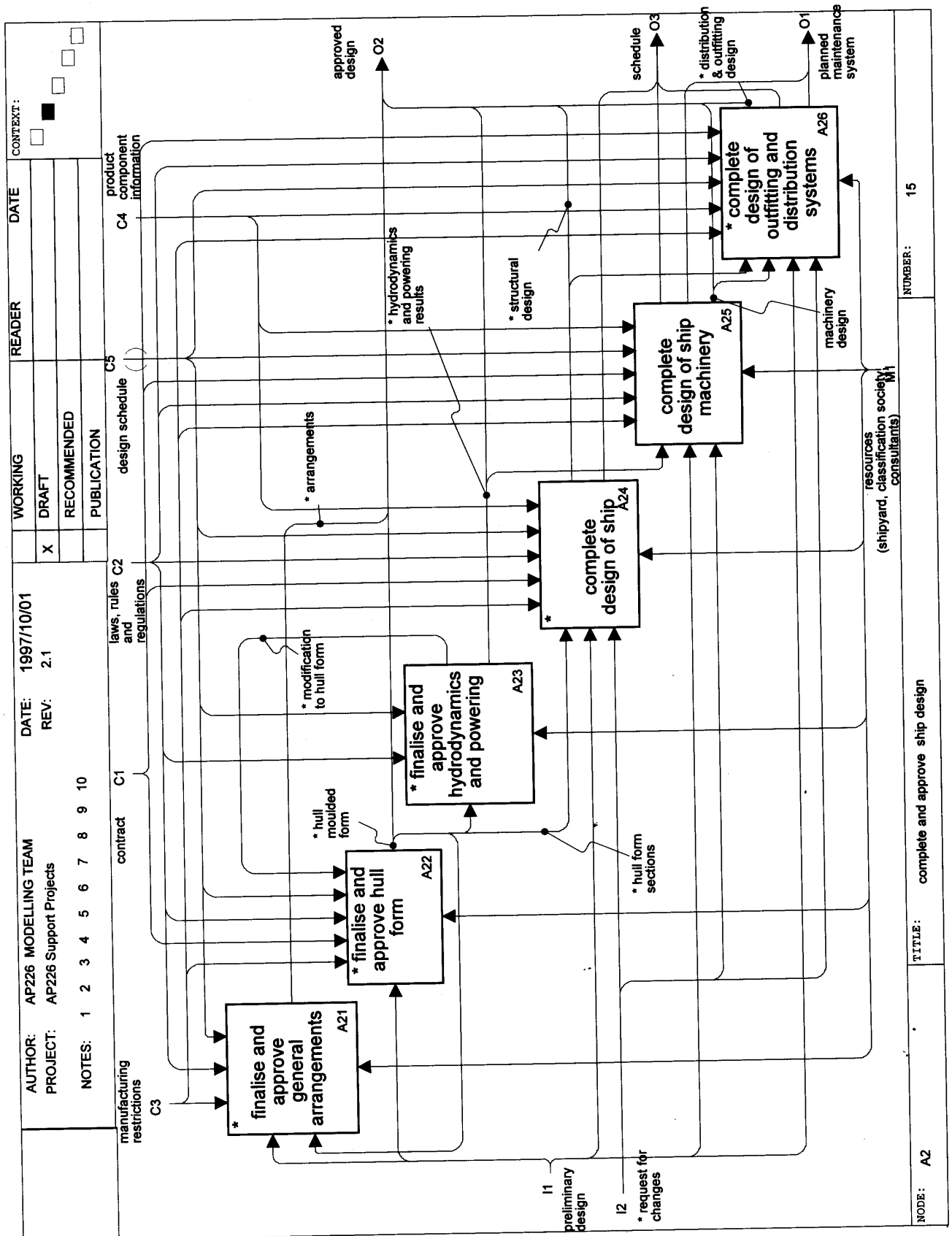


Figure F.15 – Node A2: complete and approve ship design

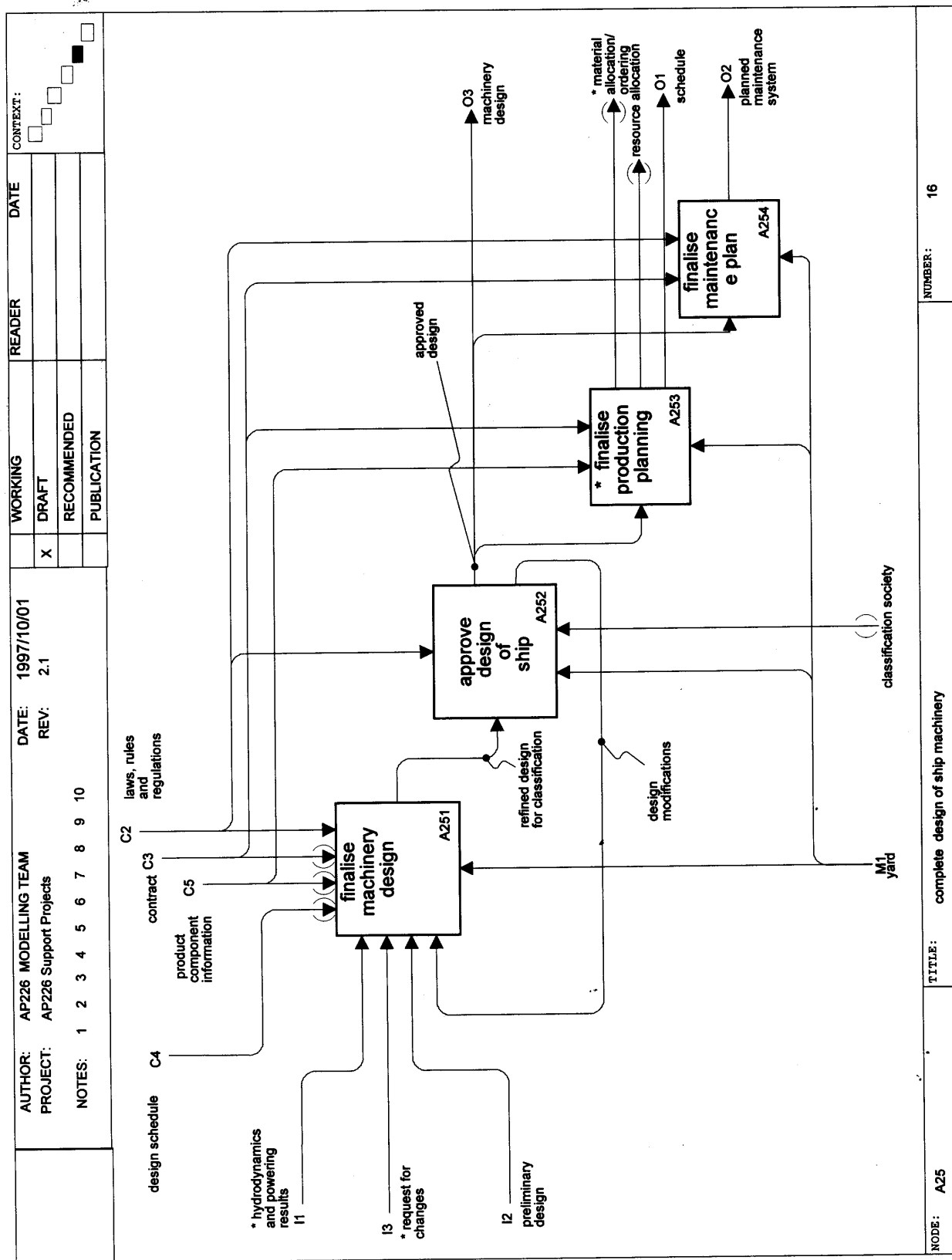


Figure F.16 – Node A25: complete design of ship machinery

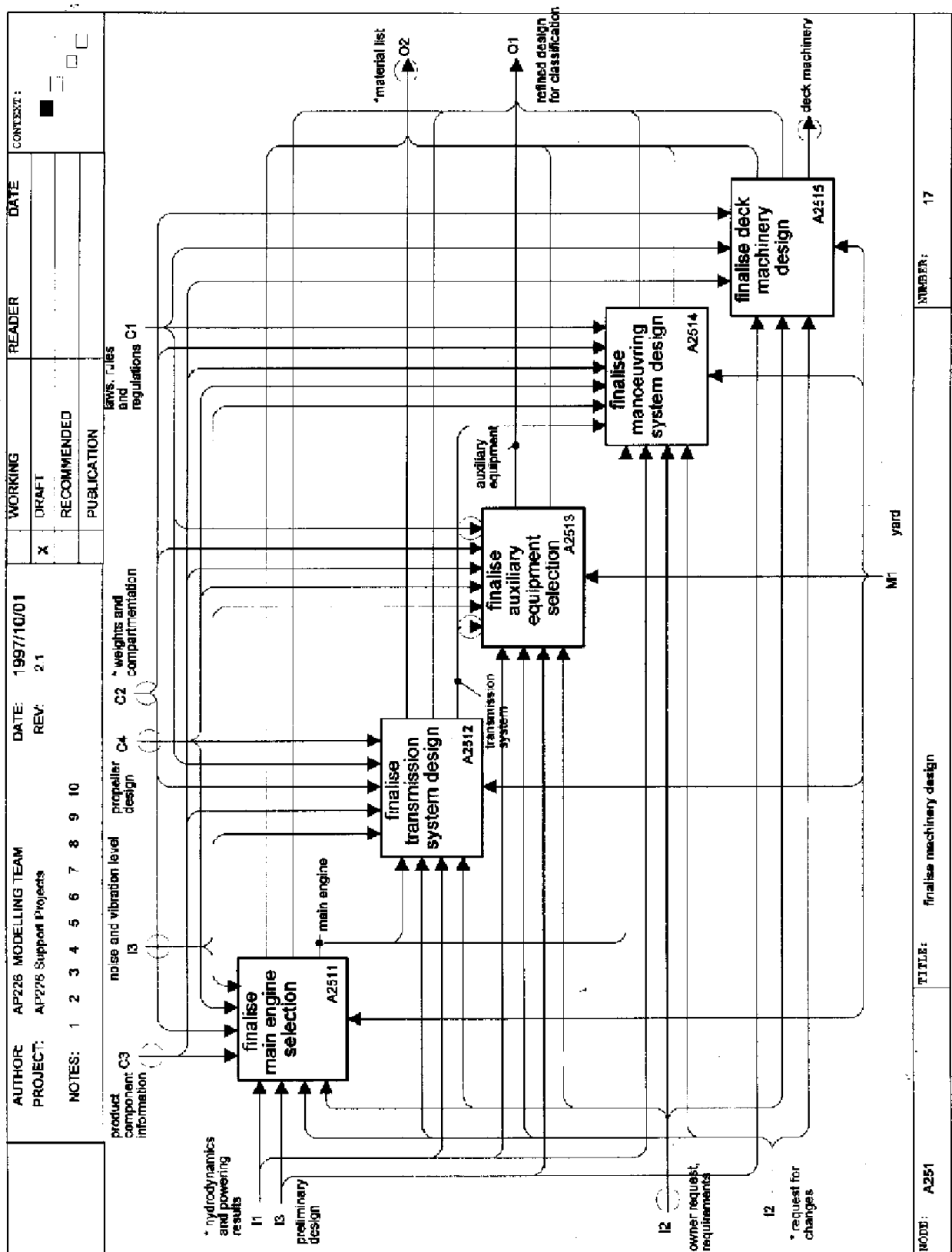


Figure F.17 – Node A251: finalise machinery design

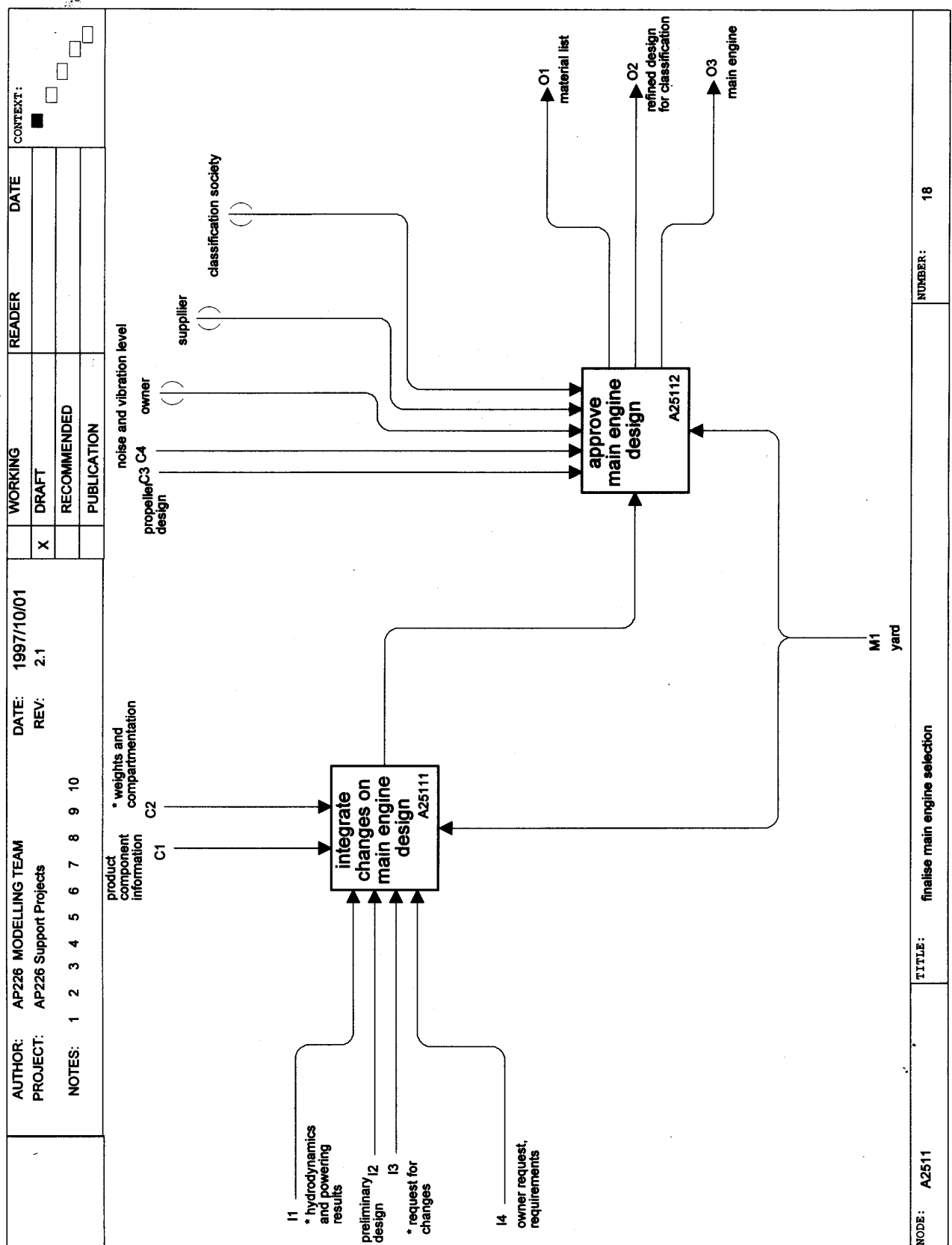


Figure F.18 – Node A2511: finalise main engine selection

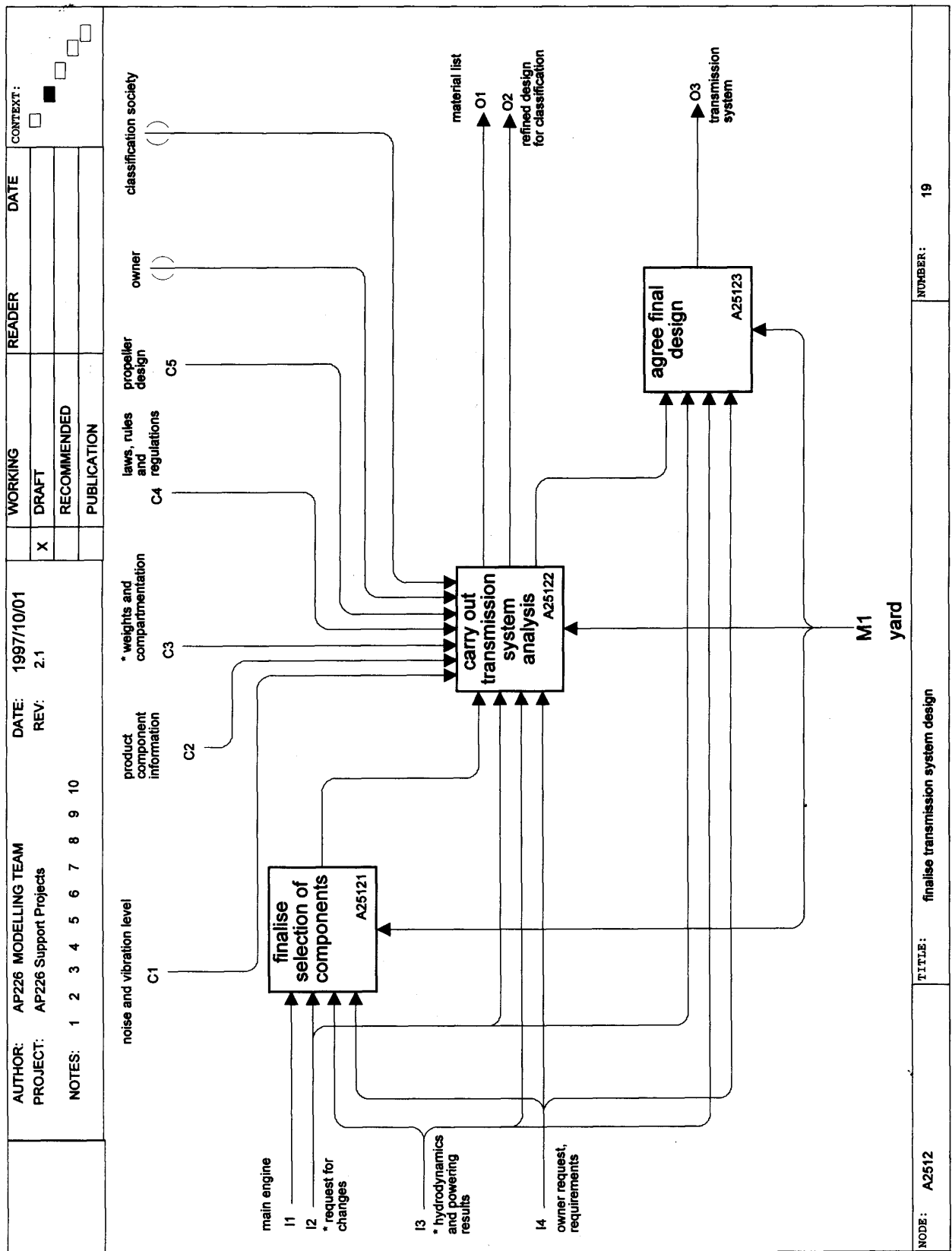


Figure F.19 – Node A2512: finalise transmission system design

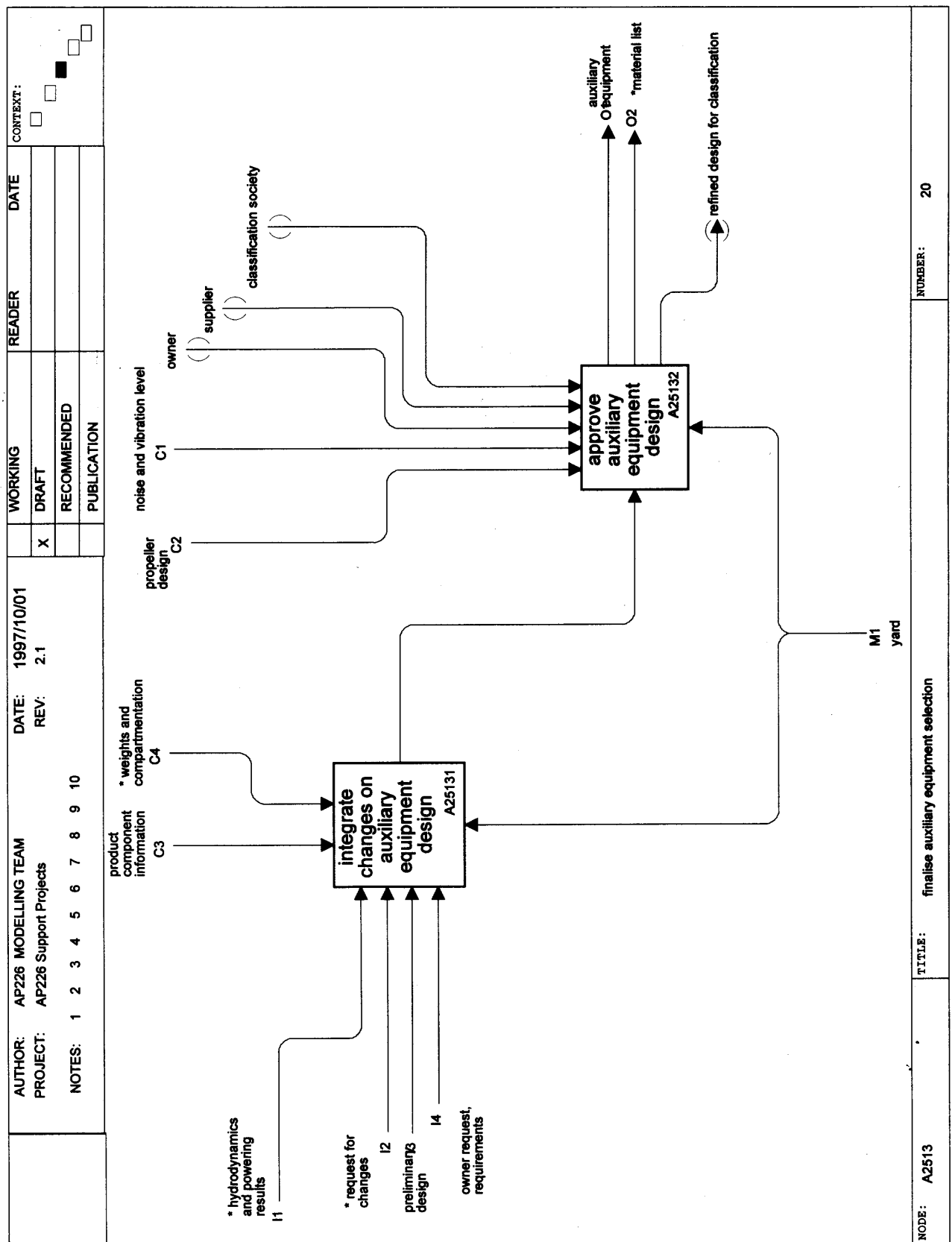


Figure F.20 – Node A2513: finalise auxiliary equipment selection

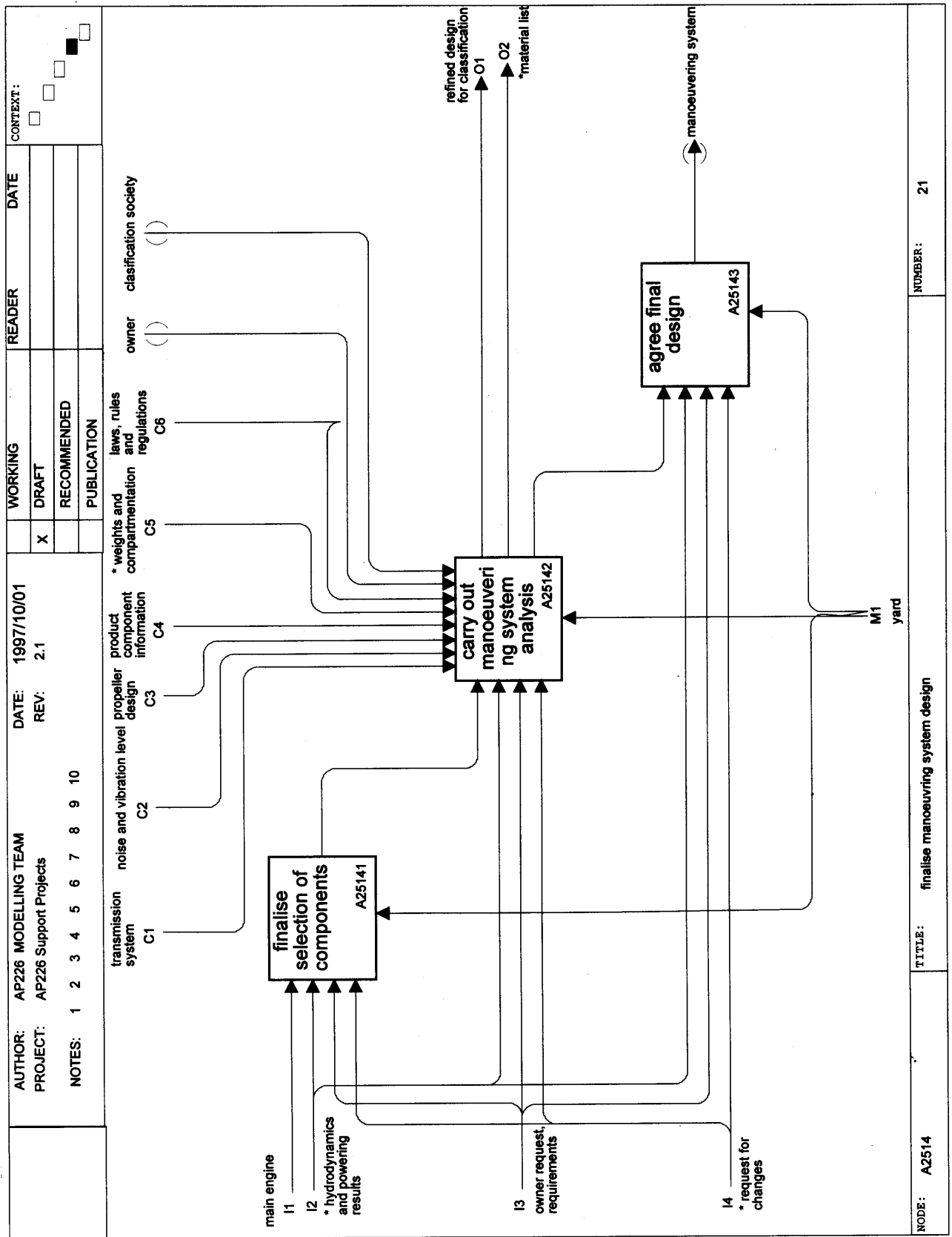


Figure F.21 – Node A2514: finalise manoeuvring system design

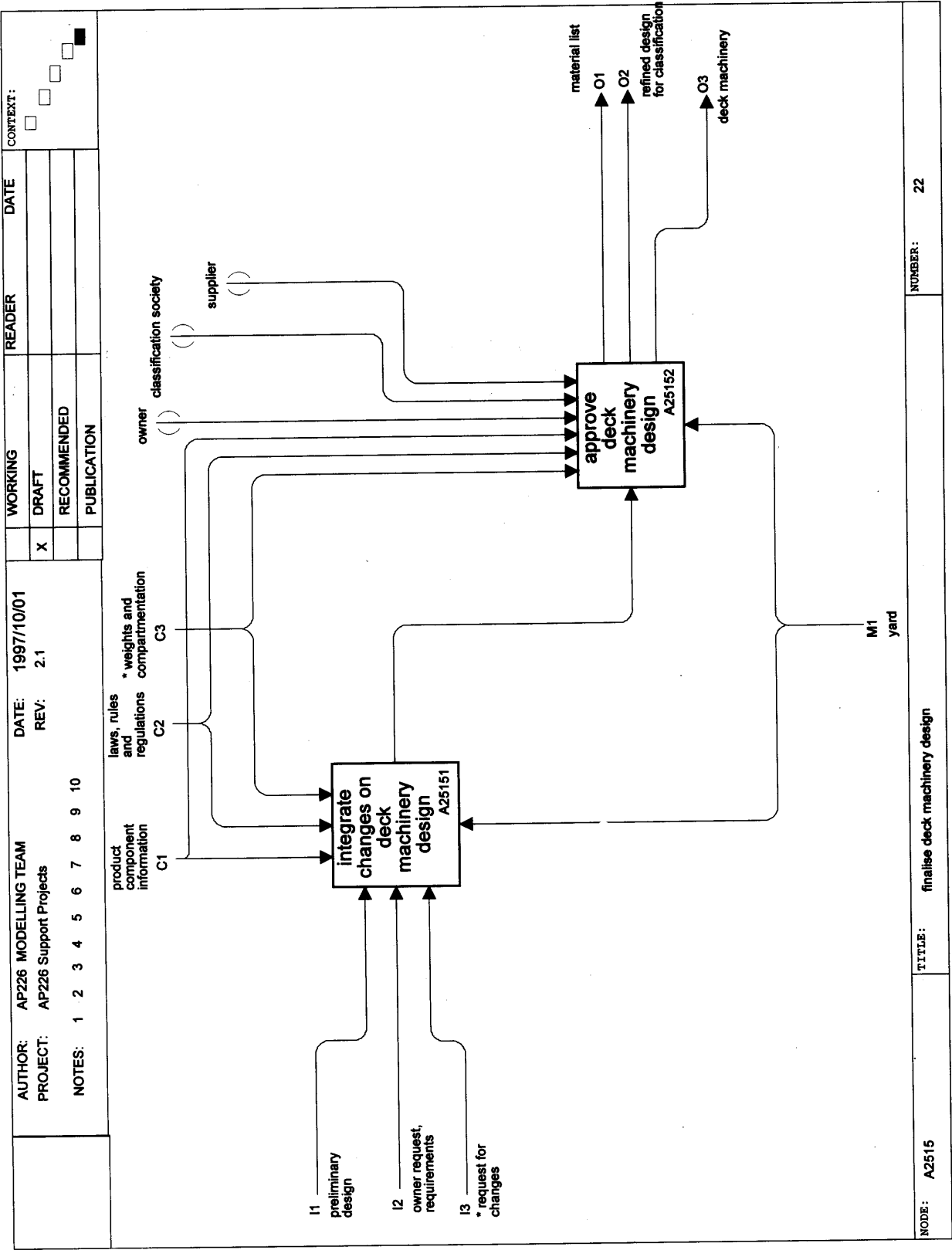


Figure F.22 – Node A2515: finalise deck machinery design

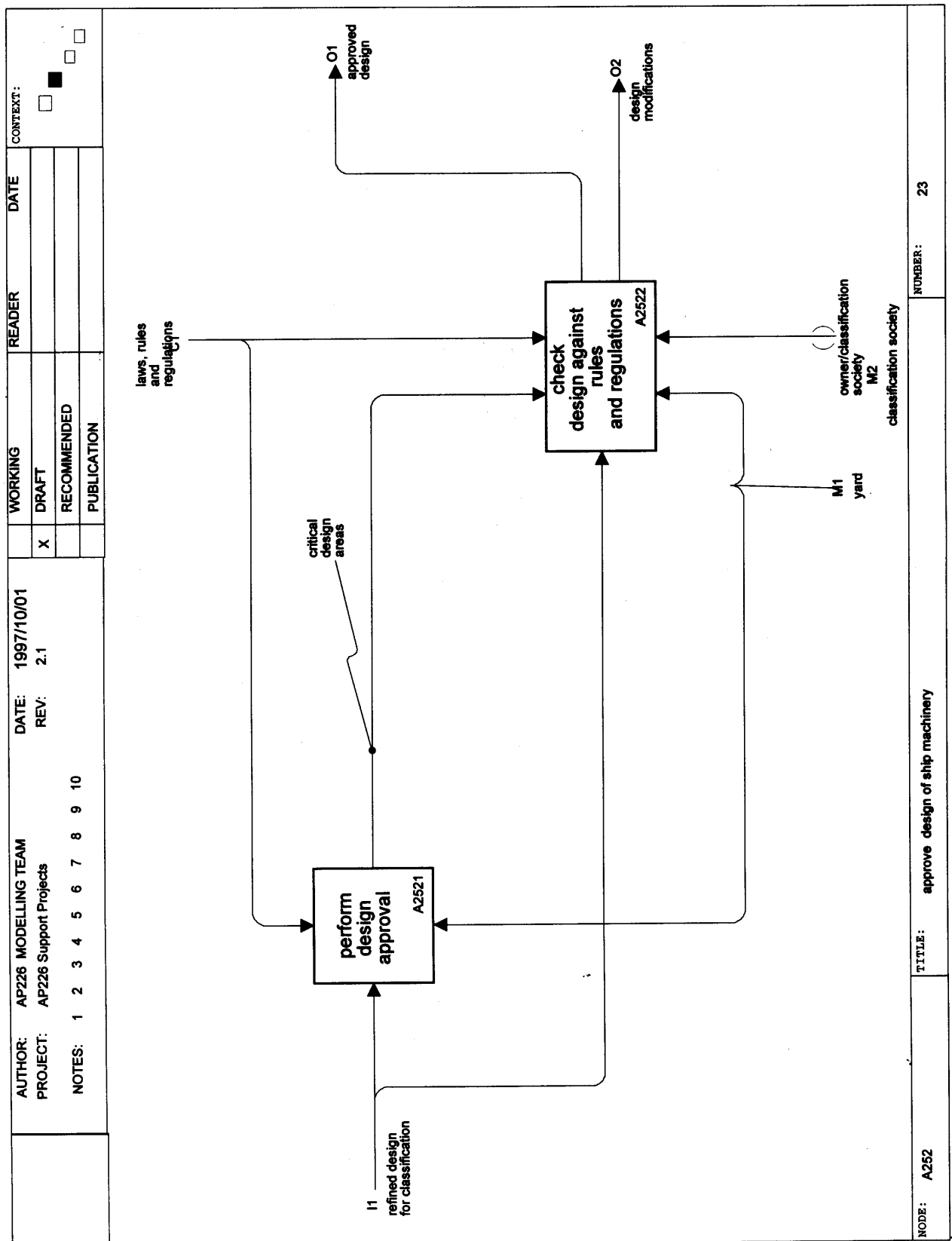


Figure F.23 – Node A252: approve design of ship machinery

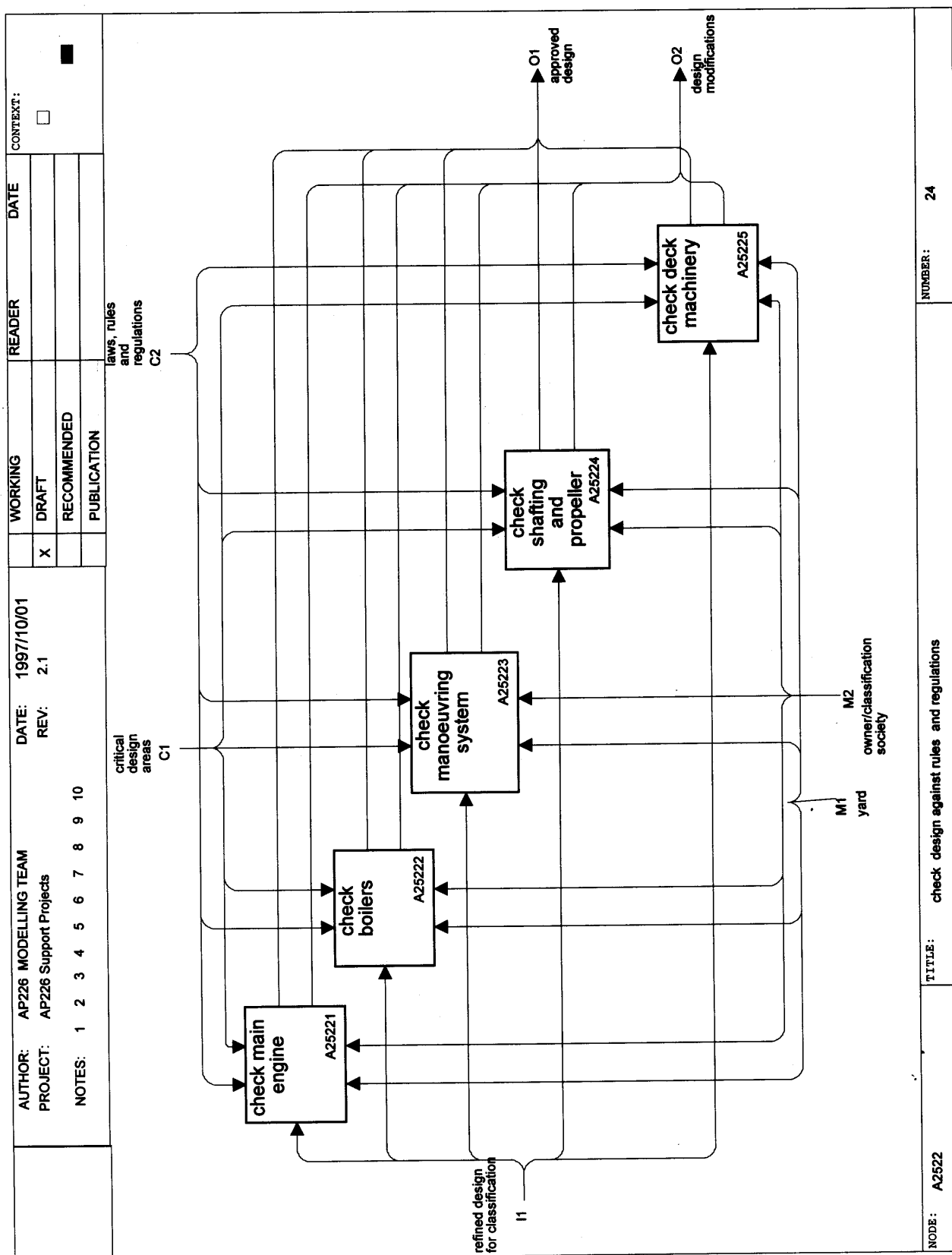


Figure F.24 – Node A2522: check design against rules and regulations

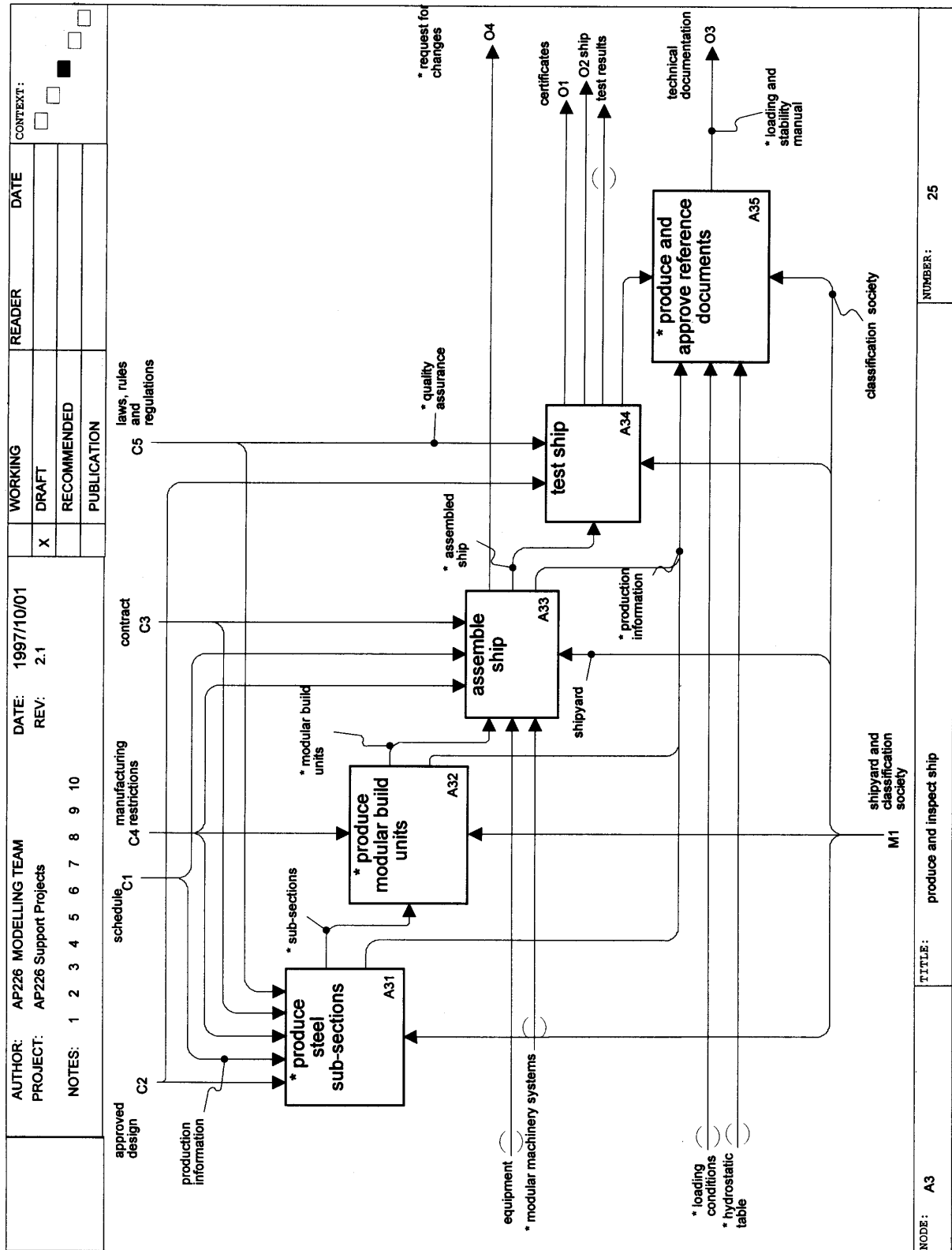


Figure F.25 – Node A3: produce and inspect ship

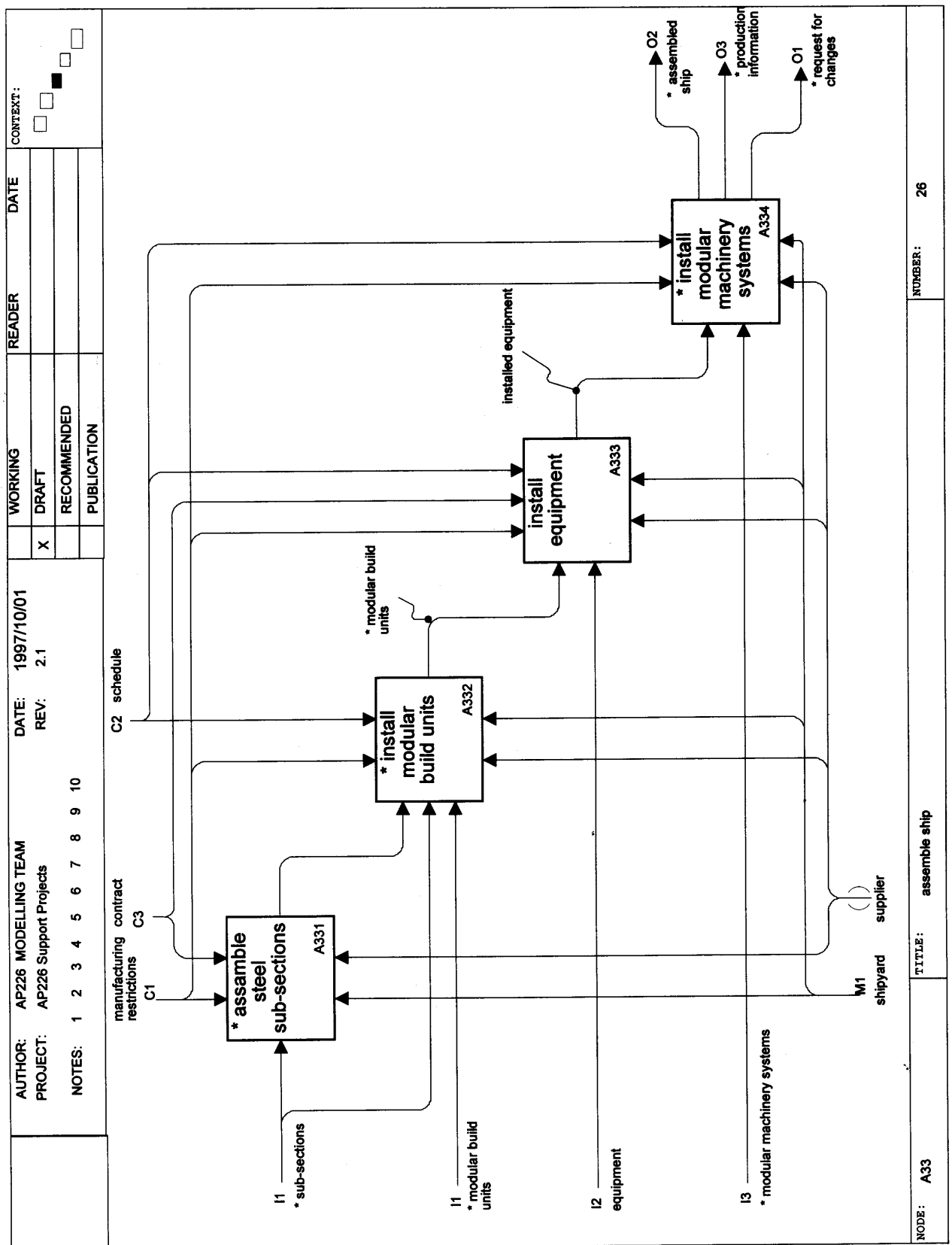


Figure F.26 – Node A33: assemble ship

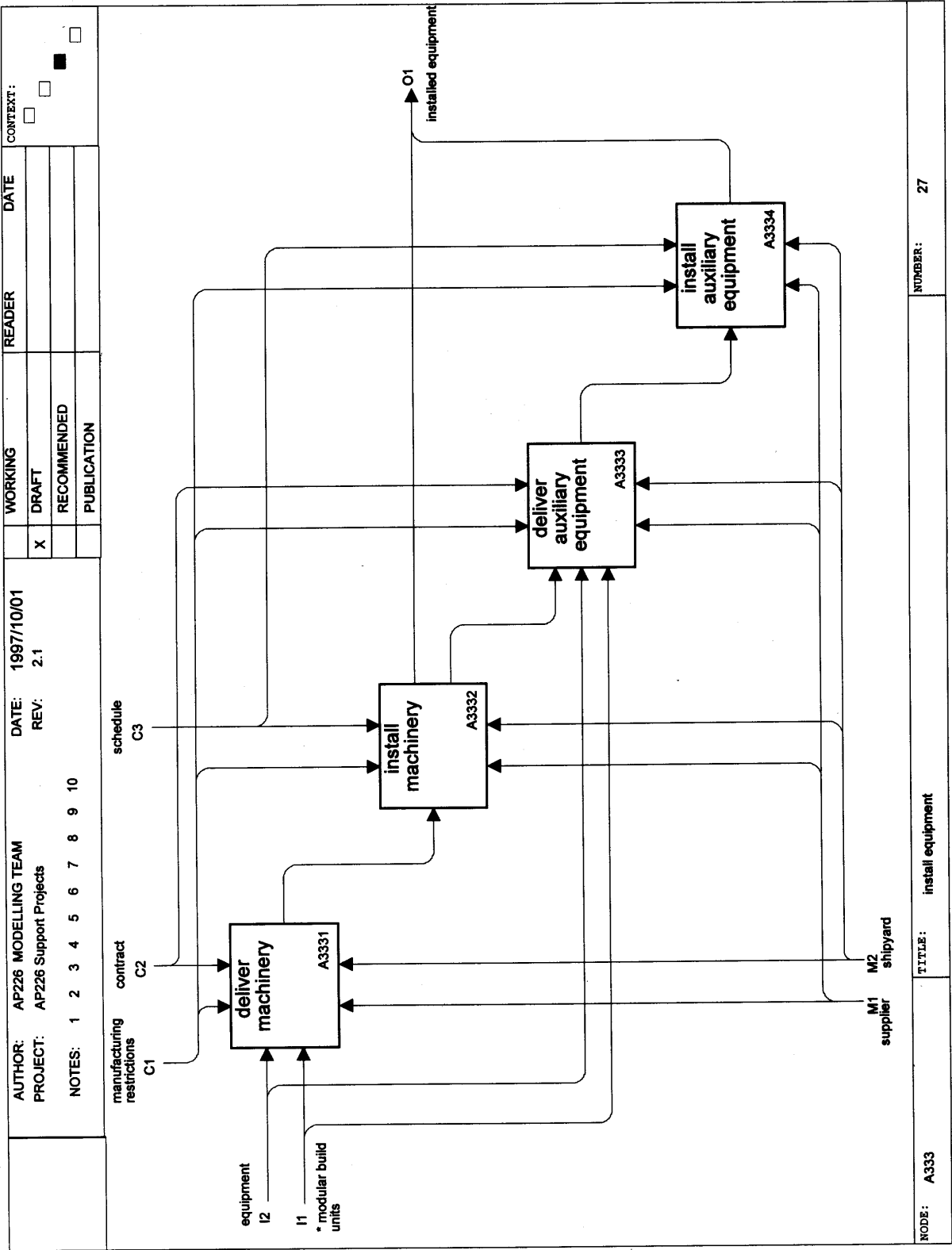


Figure F.27 – Node A333: install equipment

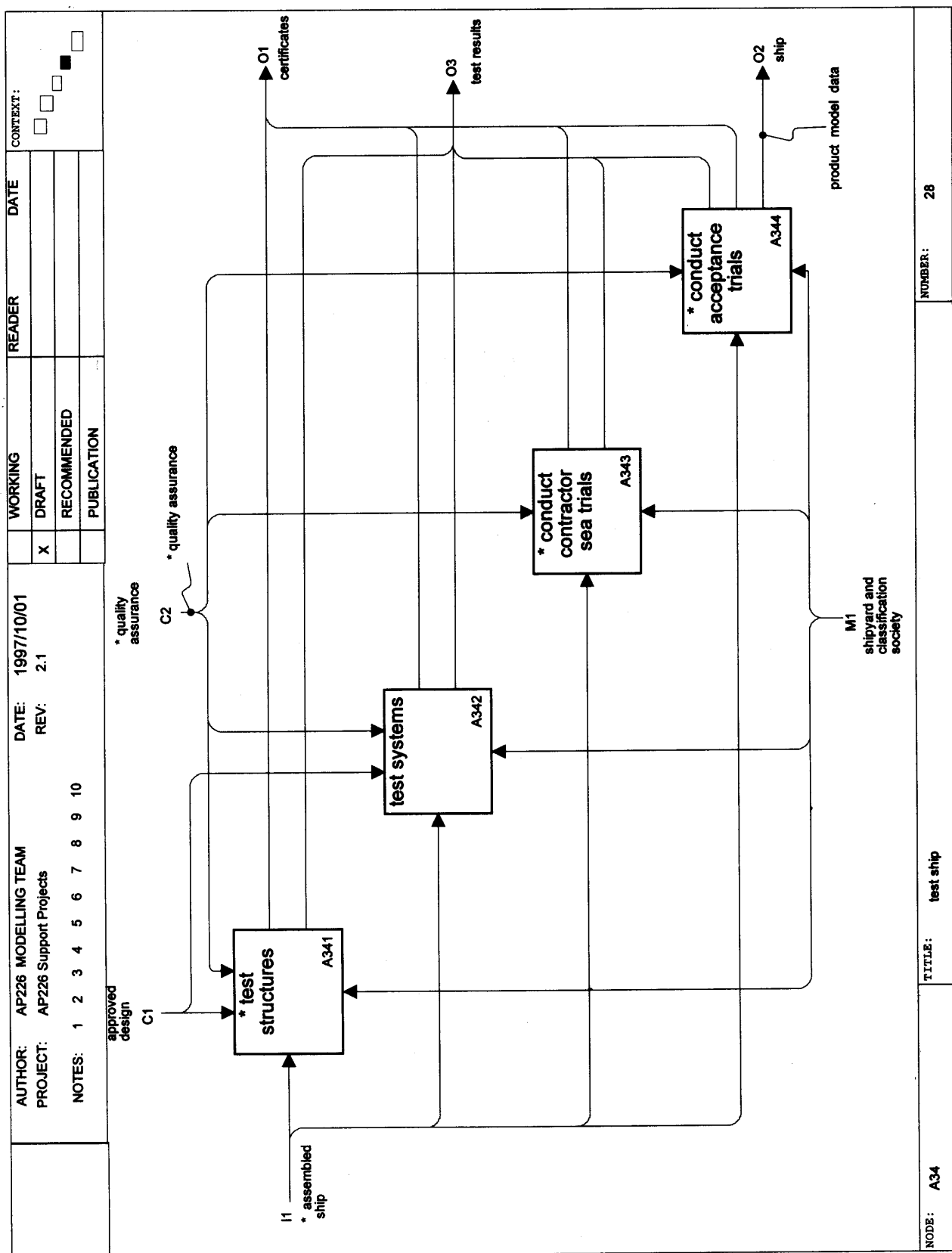


Figure F.28 – Node A34: test ship

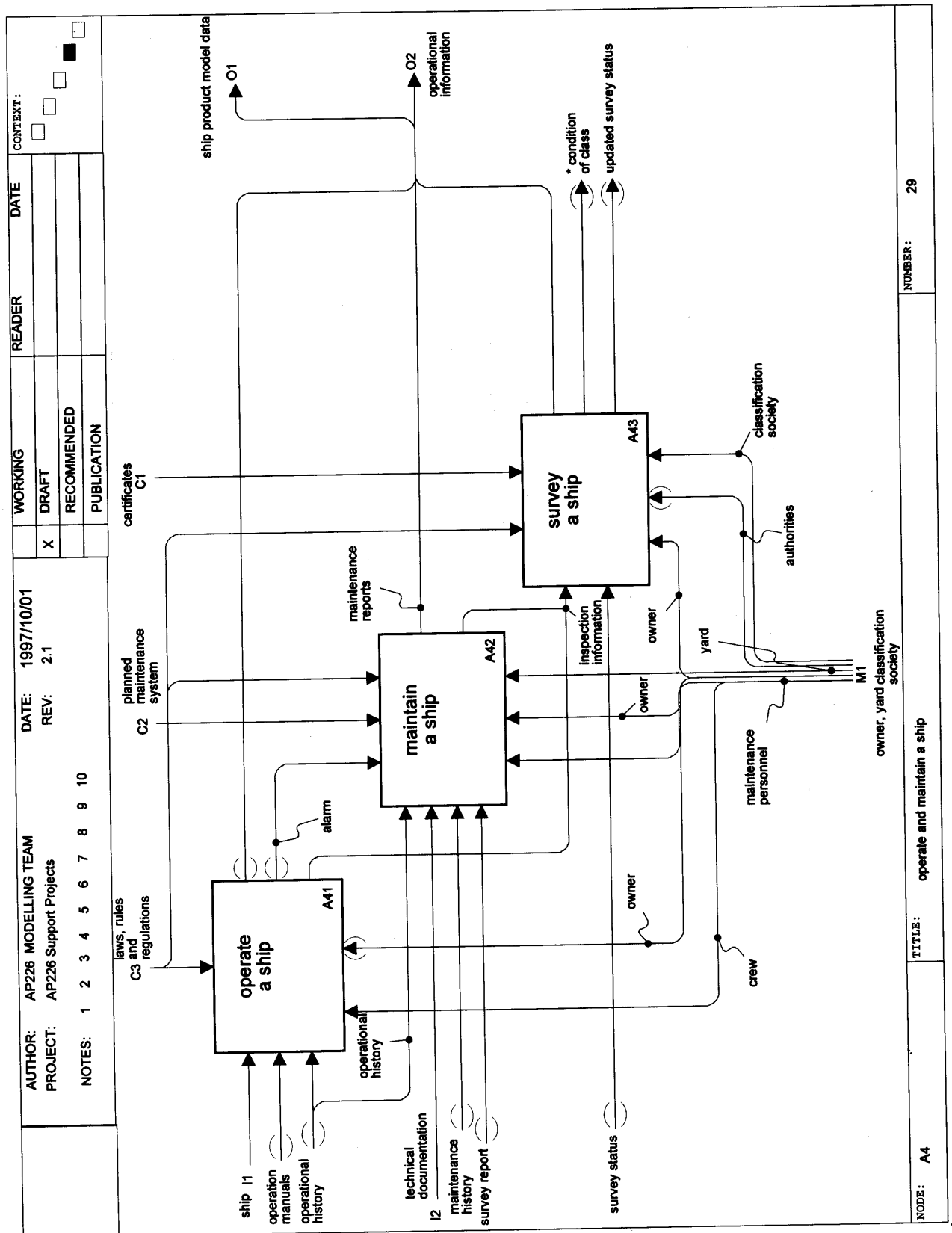


Figure F.29 – Node A4: operate and maintain a ship

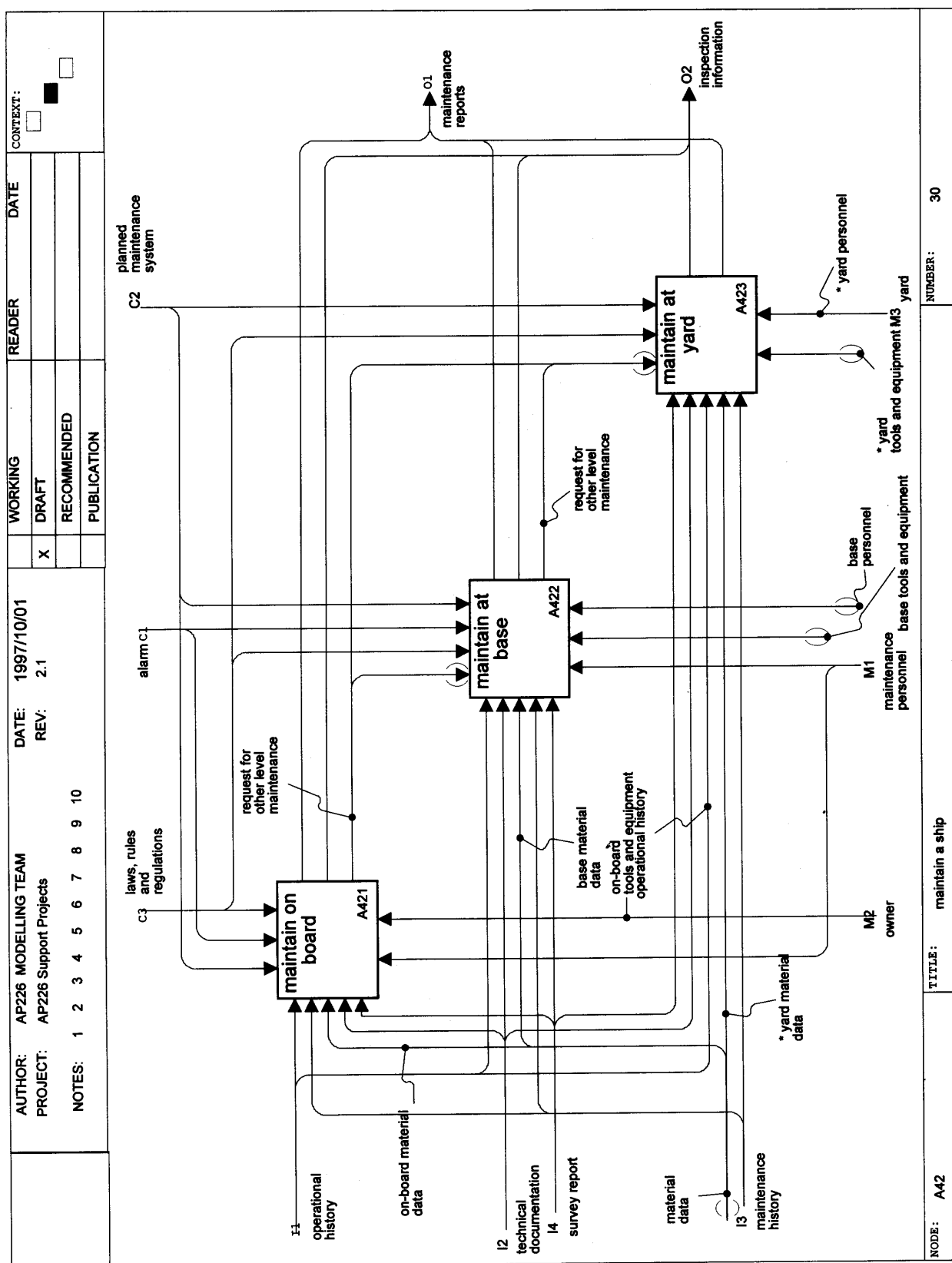


Figure F.30 – Node A42: maintain a ship

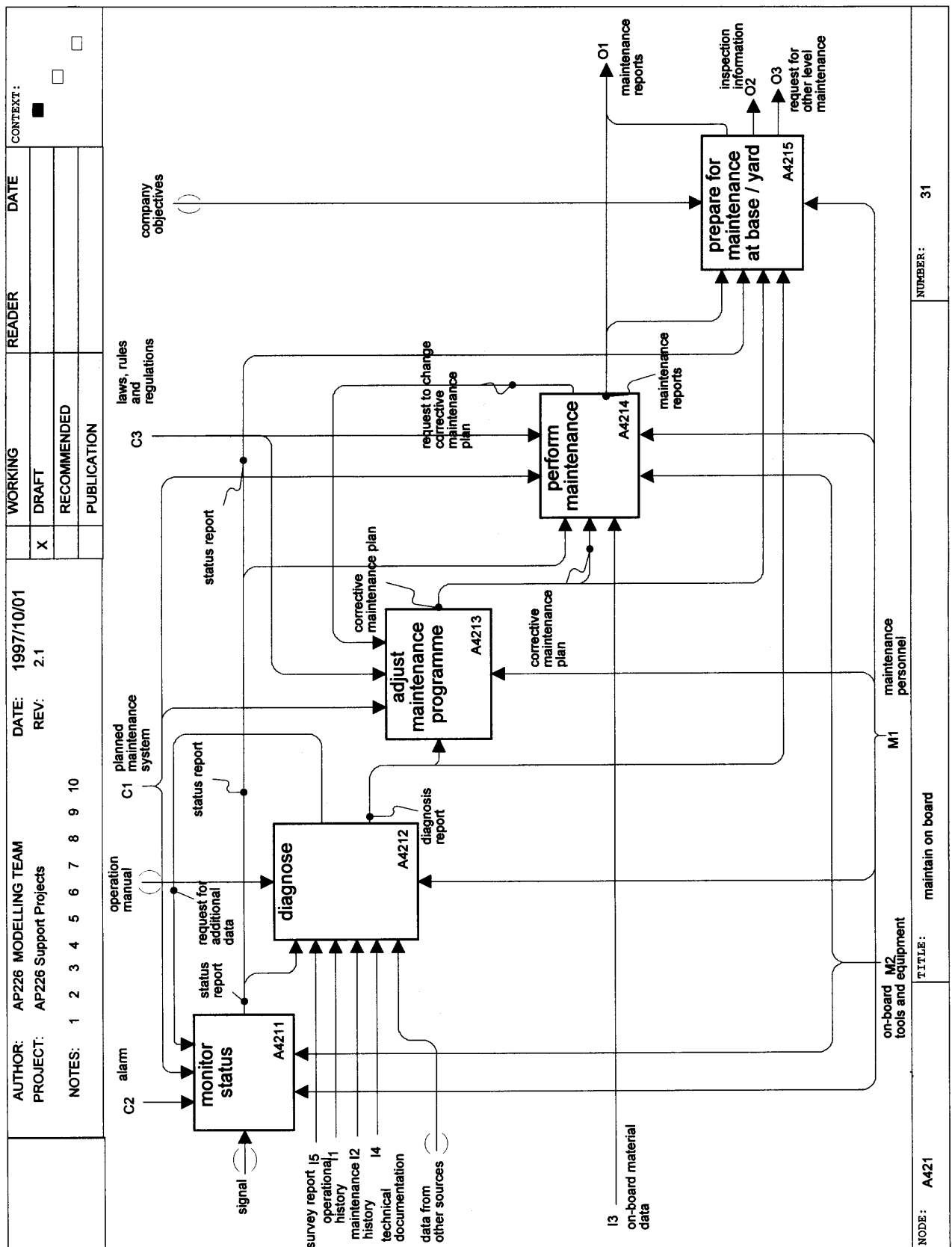


Figure F.31 – Node A421: maintain on board

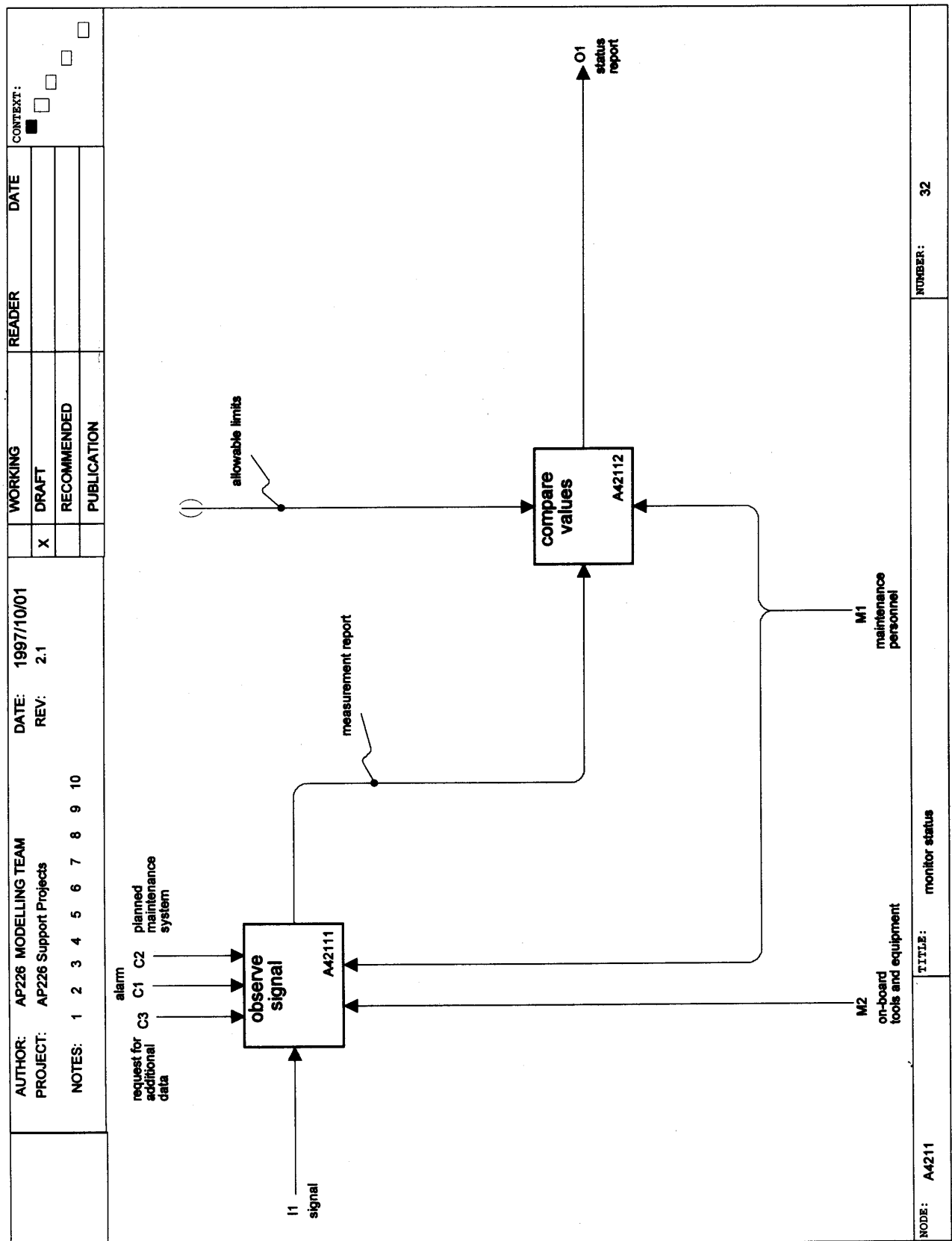


Figure F.32 – Node A4211: monitor status

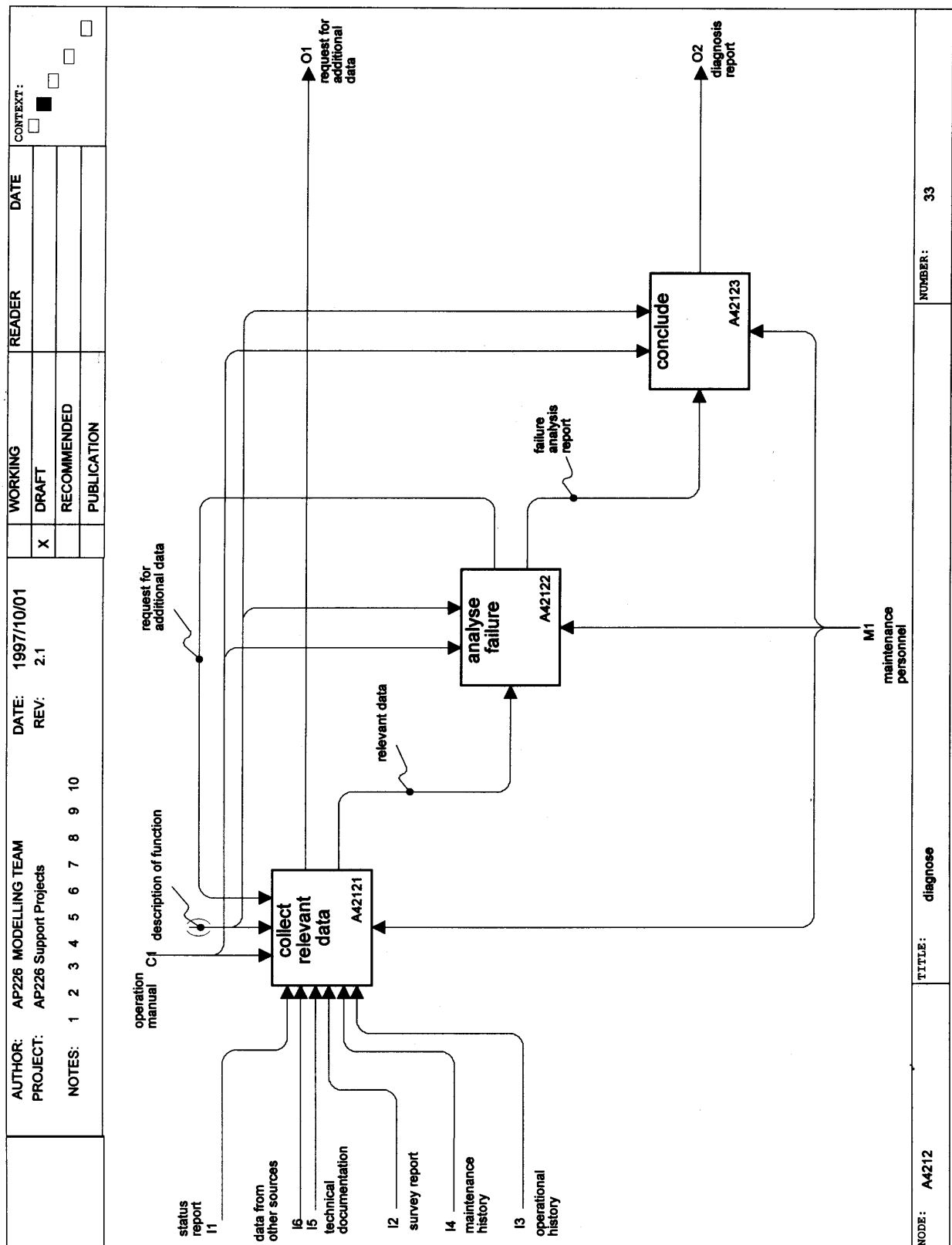


Figure F.33 – Node A4212: diagnose

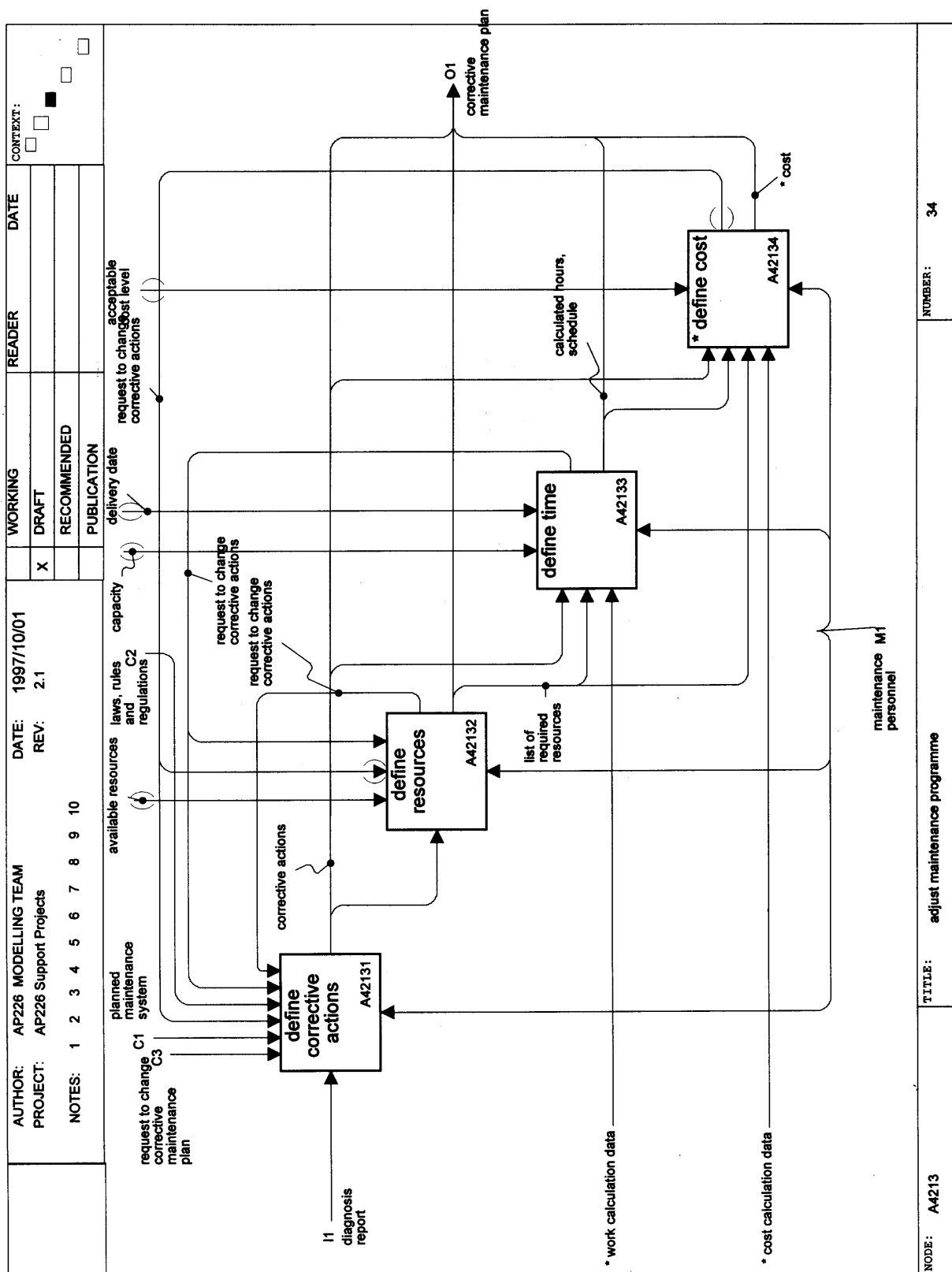


Figure F.34 – Node A4213: adjust maintenance programme

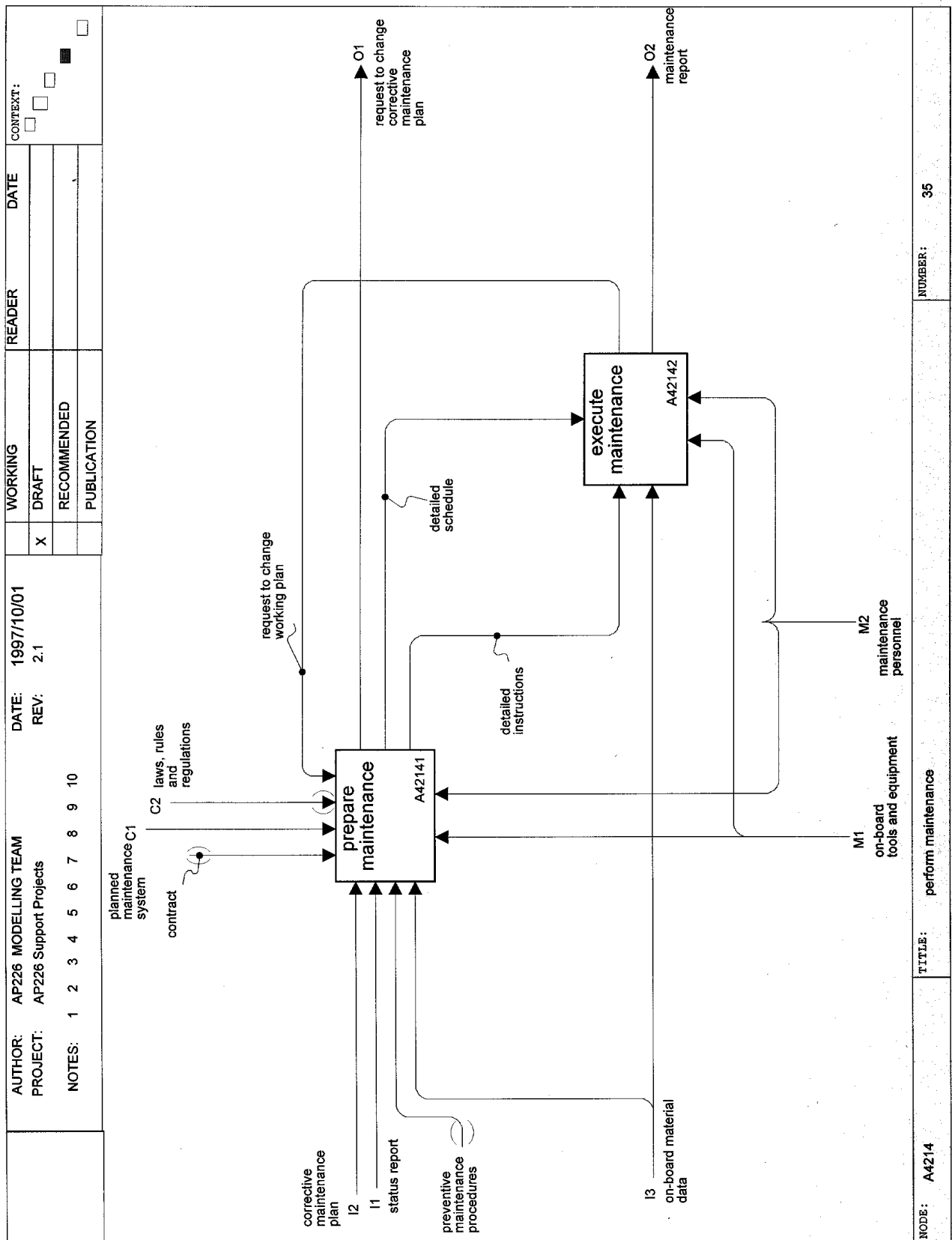


Figure F.35 – Node A4214: perform maintenance

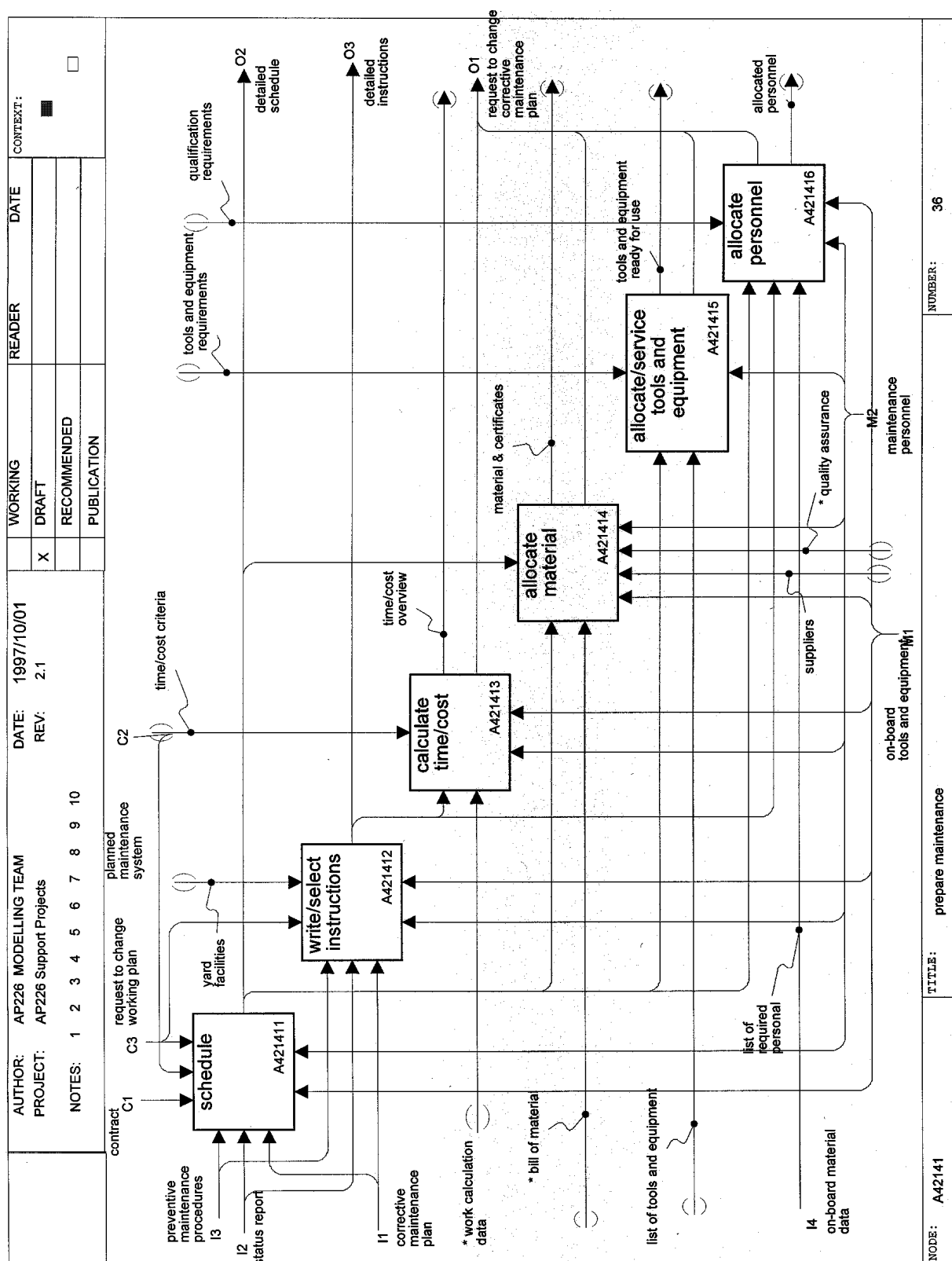


Figure F.36 – Node A42141: prepare maintenance

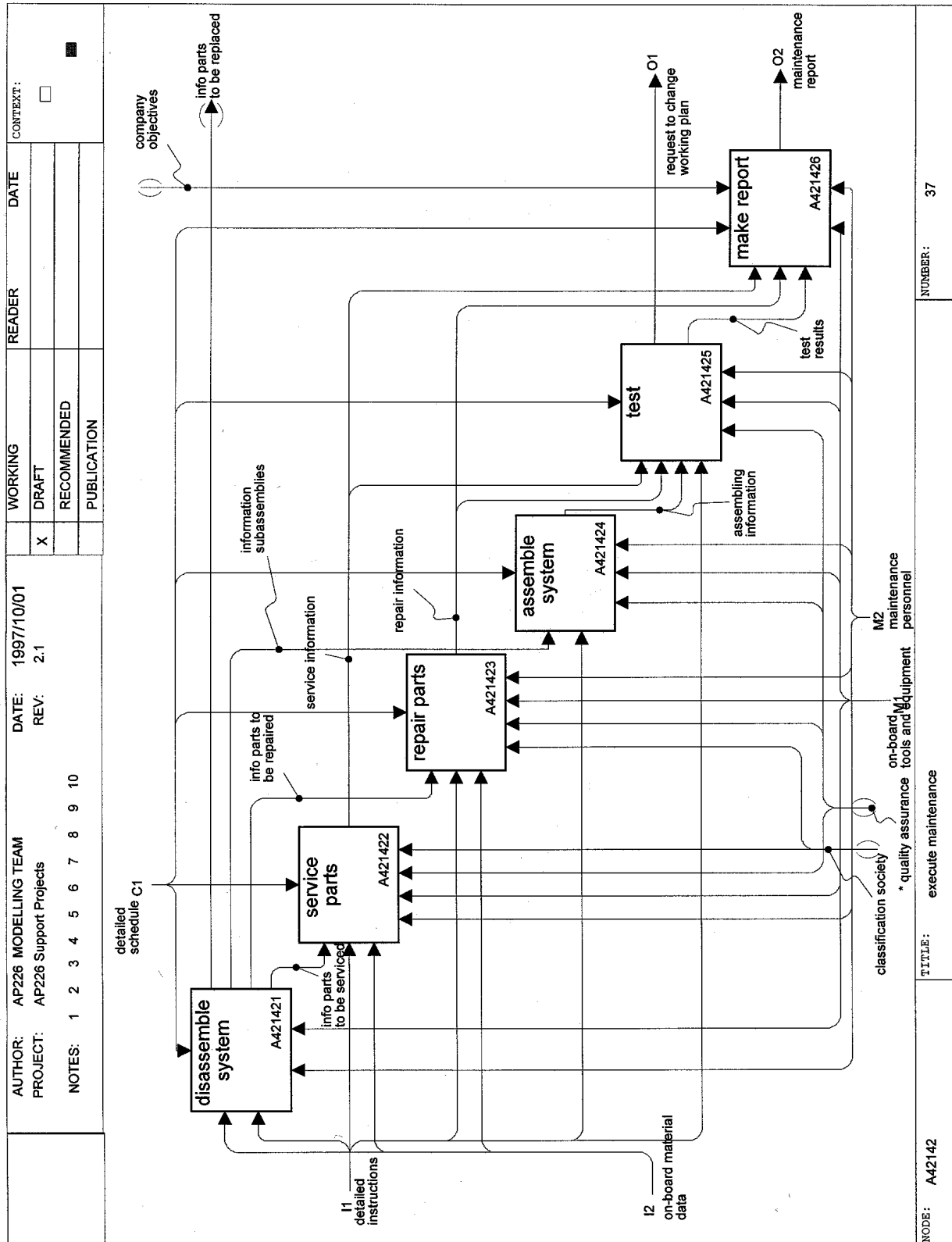


Figure F.37 – Node A42142: execute maintenance

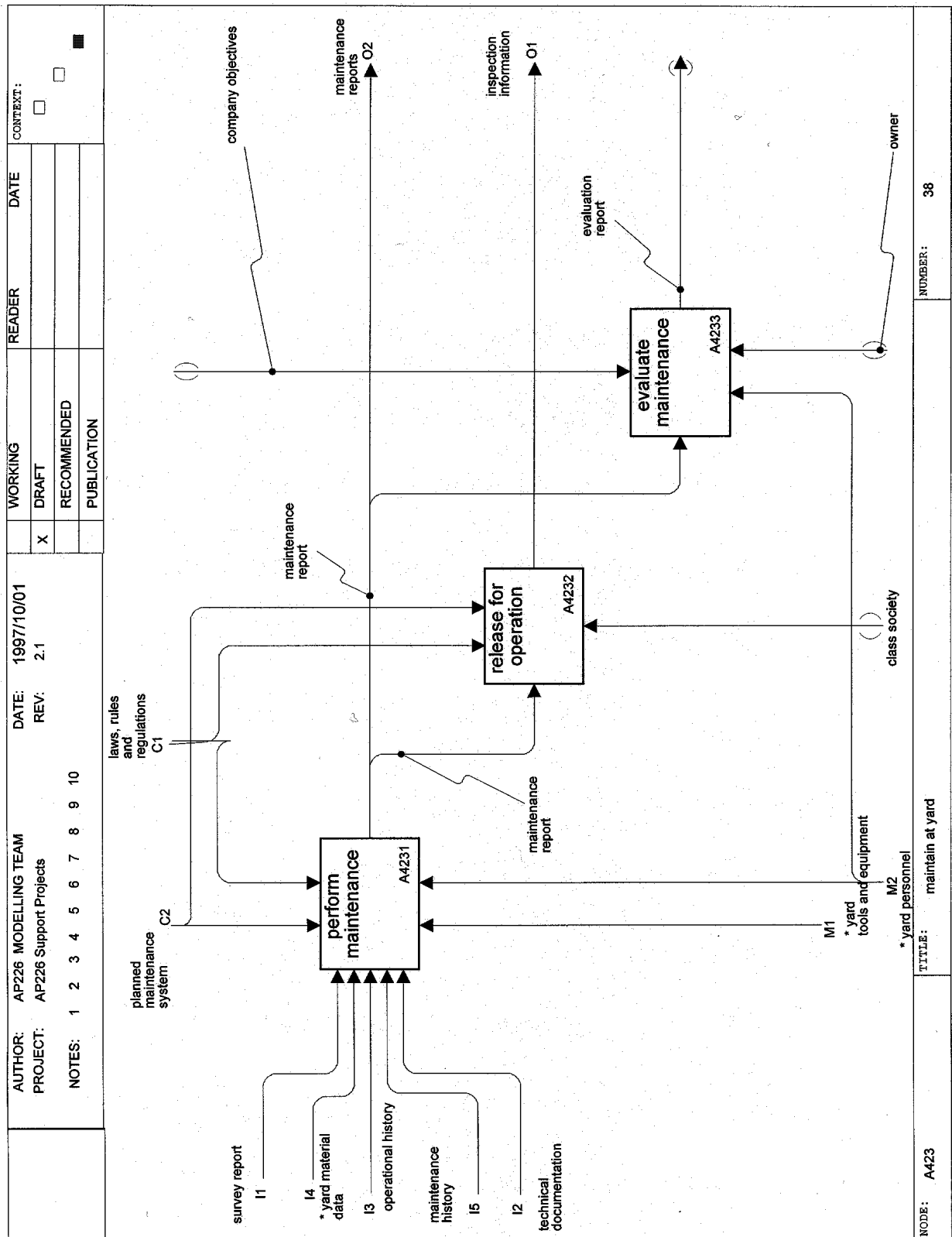


Figure F.38 – Node A423: maintain at yard

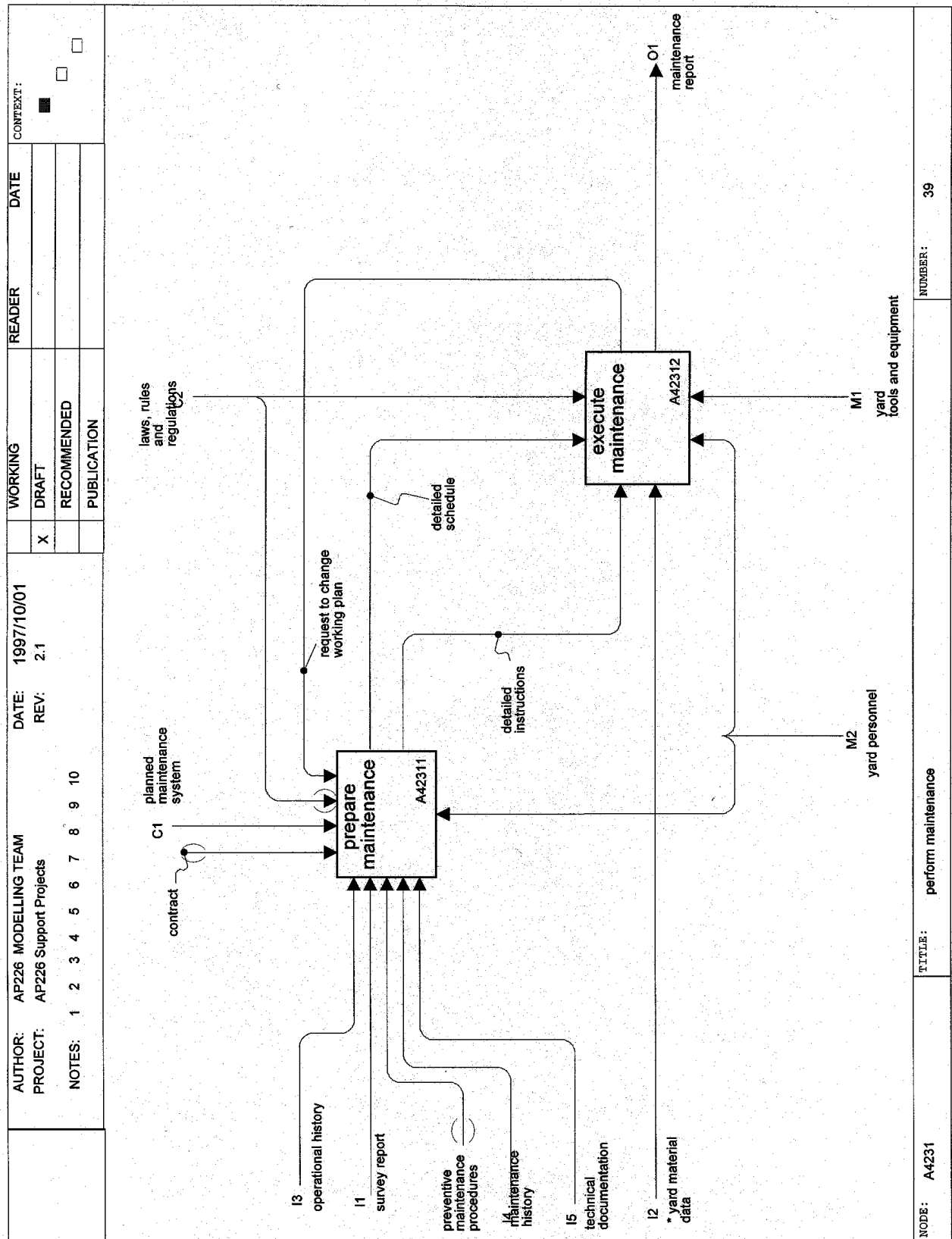


Figure F.39 – Node A4231: perform maintenance

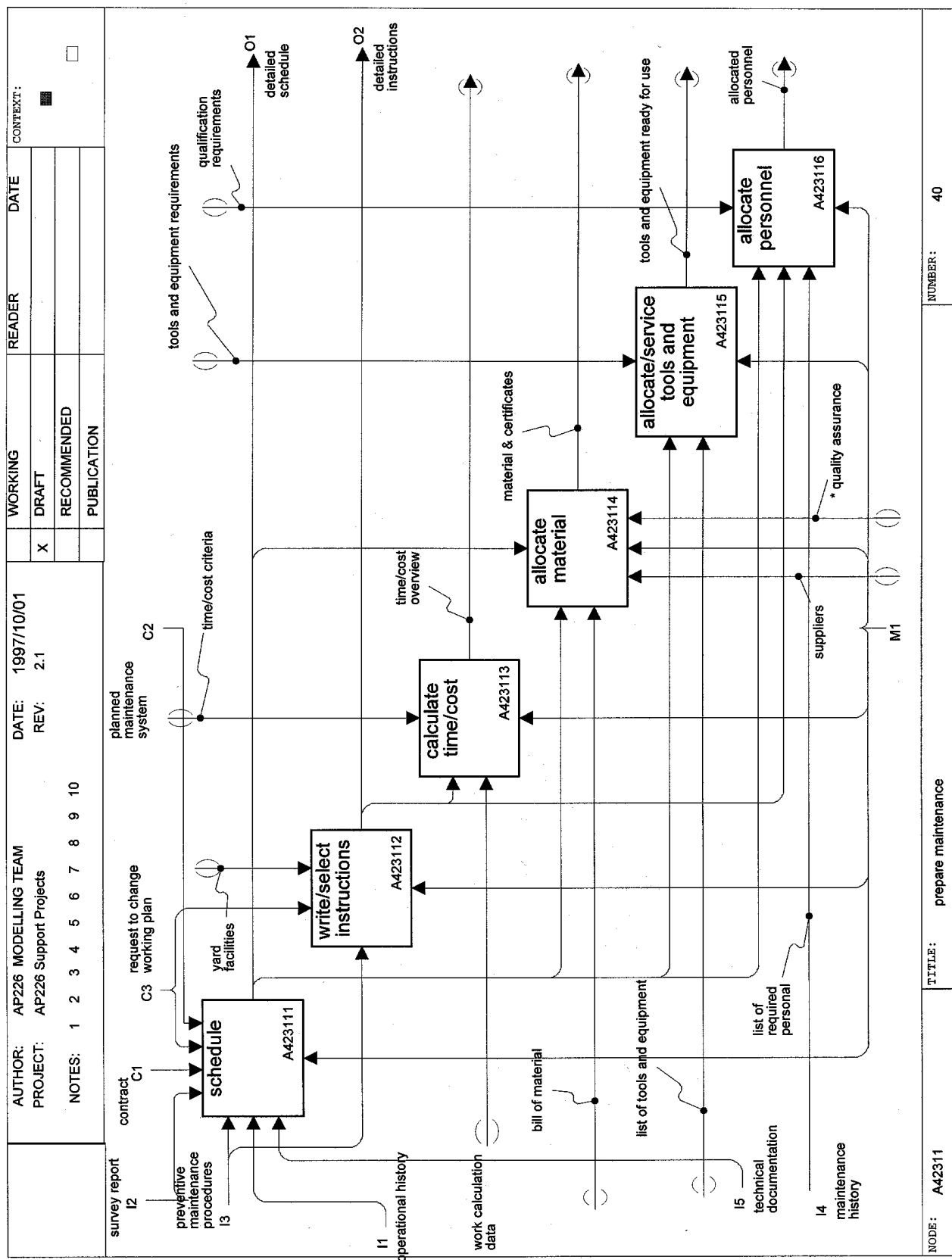


Figure F.40 – Node A42311: prepare maintenance

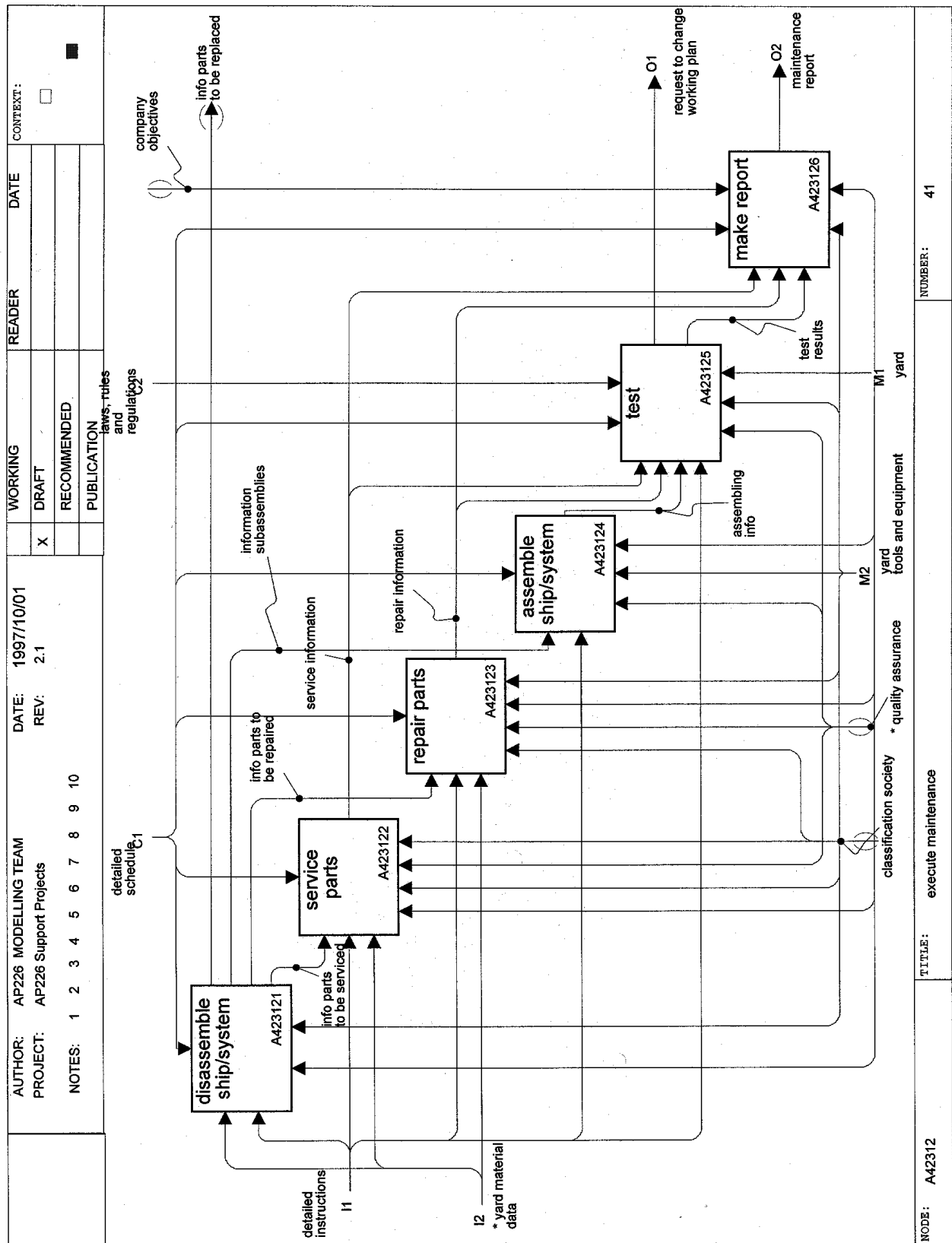


Figure F.41 – Node A42312: execute maintenance

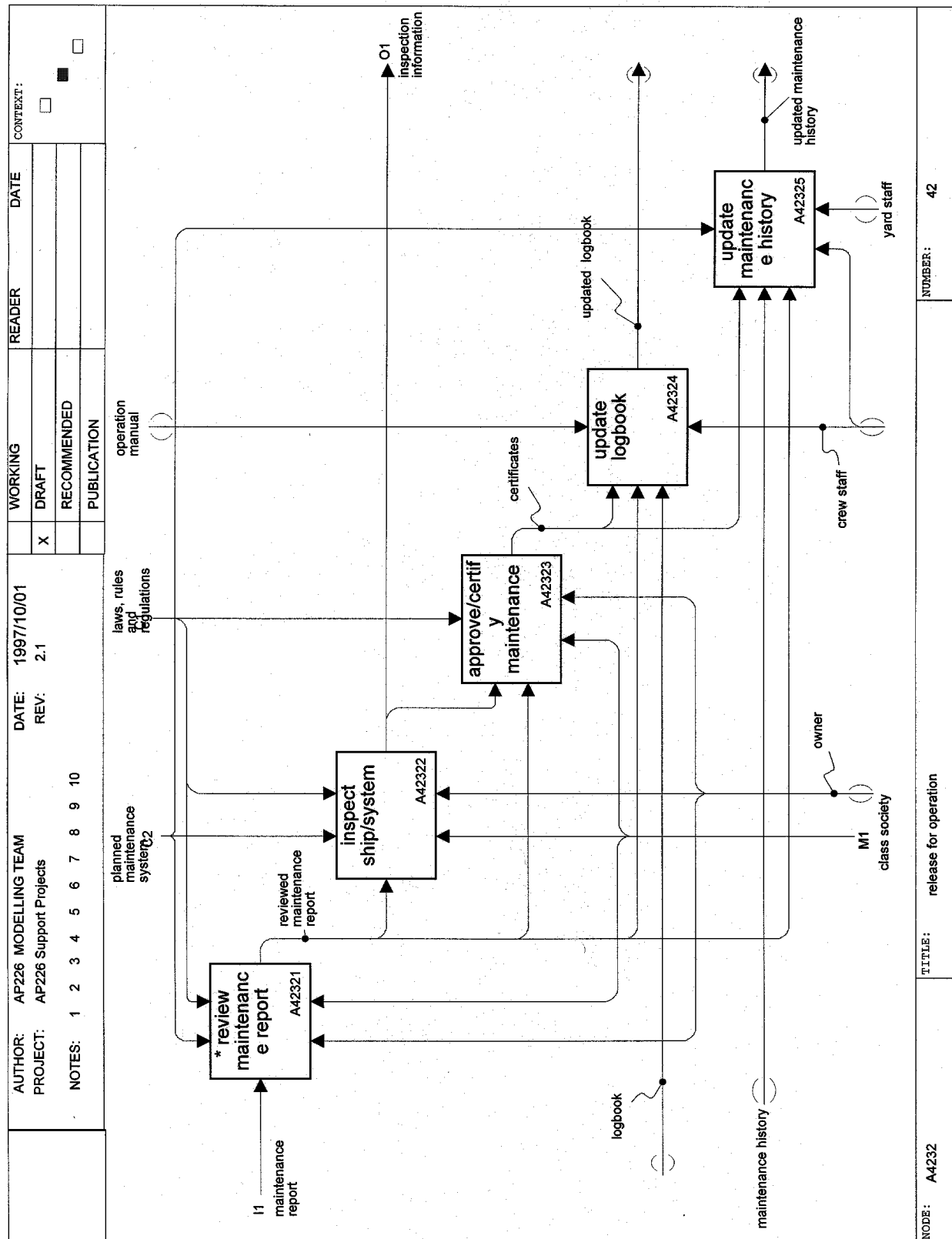


Figure F.42 – Node A4232: release for operation

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AP226 Support Projects

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WORKING	READER	DATE
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C1 laws, rules and regulations

C2 certificates

survey planning A432

notify owner about items due for survey A431

prepare ship for survey A433

survey a ship A434

inspection information I1

survey status I2

M2 classification society

M1 owner

operational information O1

*** condition of class O2**

updated survey status O3

List of items to be inspected.

survey plan

preparation report

Figure F.43 – Node A43: survey a ship

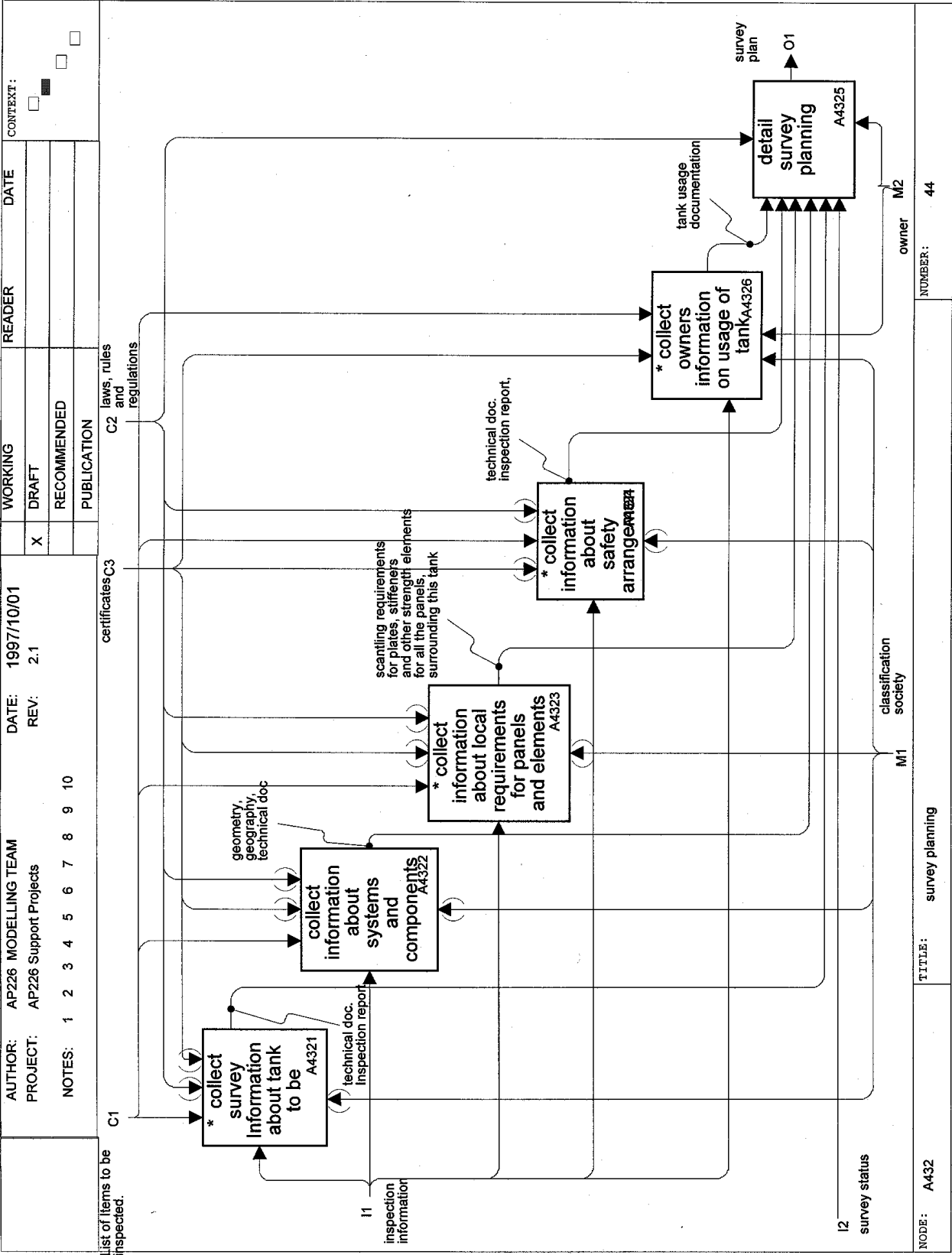


Figure F.44 – Node A432: survey planning

Annex G
(informative)

Application reference model

This annex provides the application reference model (ARM) for this part of ISO 10303. The application reference model is a graphical representation of the structure and constraints of the application objects specified in clause 4. The application reference model is independent from any implementation method.

The graphical form of the application reference model is presented in EXPRESS-G. Figures G.1 to G.86 give the ARM for this part of ISO 10303.

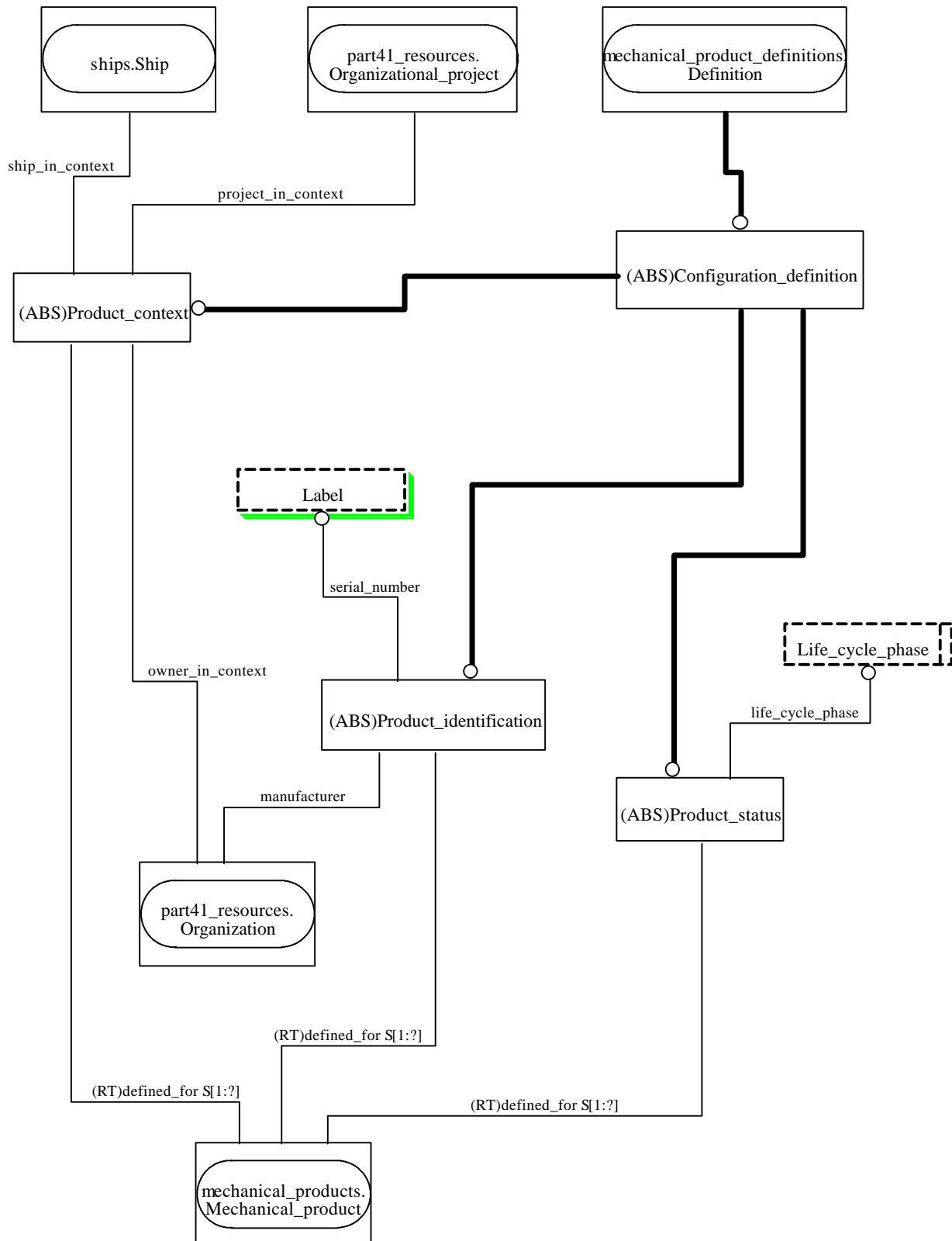


Figure G.1 - Graphical notation of the major aspects of the configuration_definitions UoF schema (figure 1 of 1)

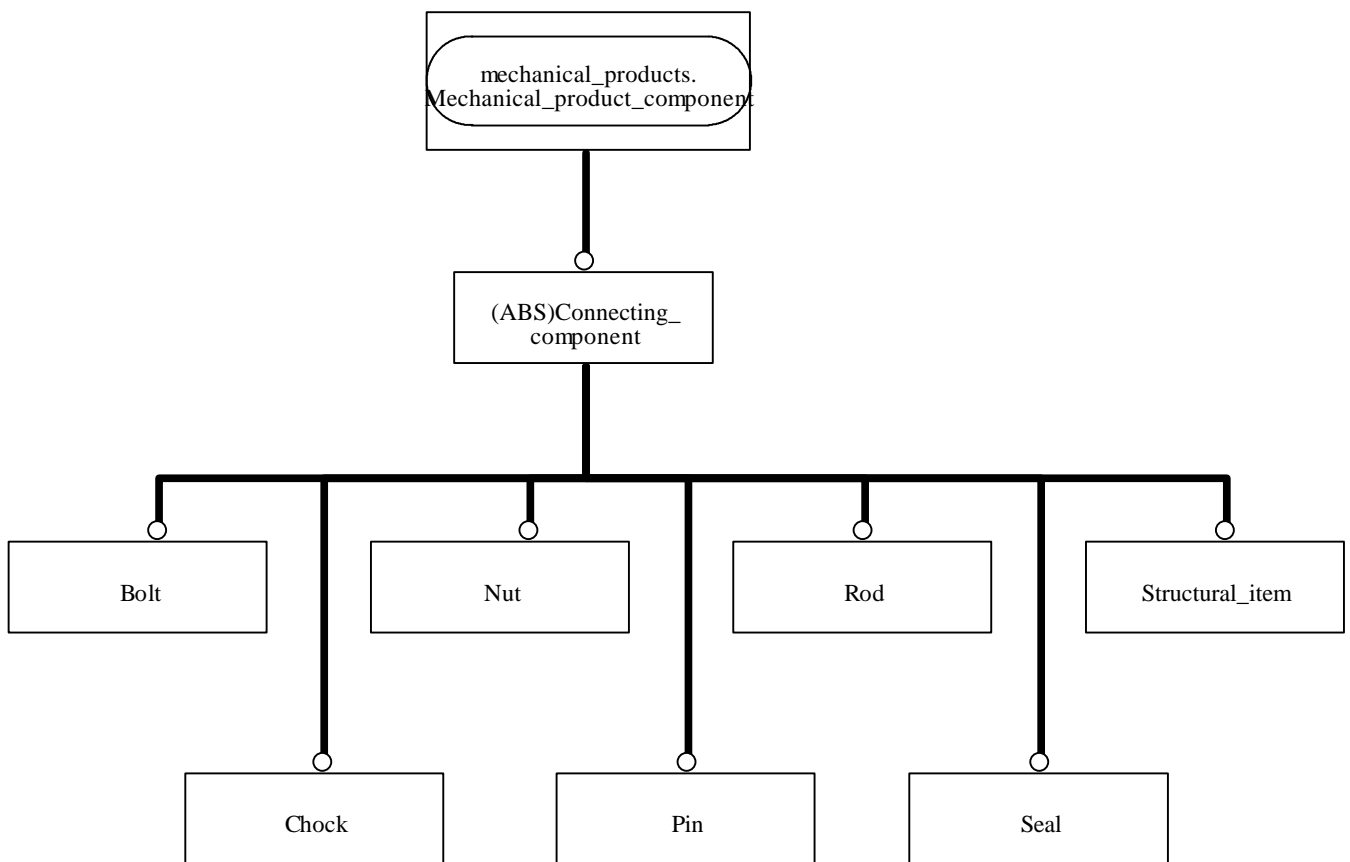
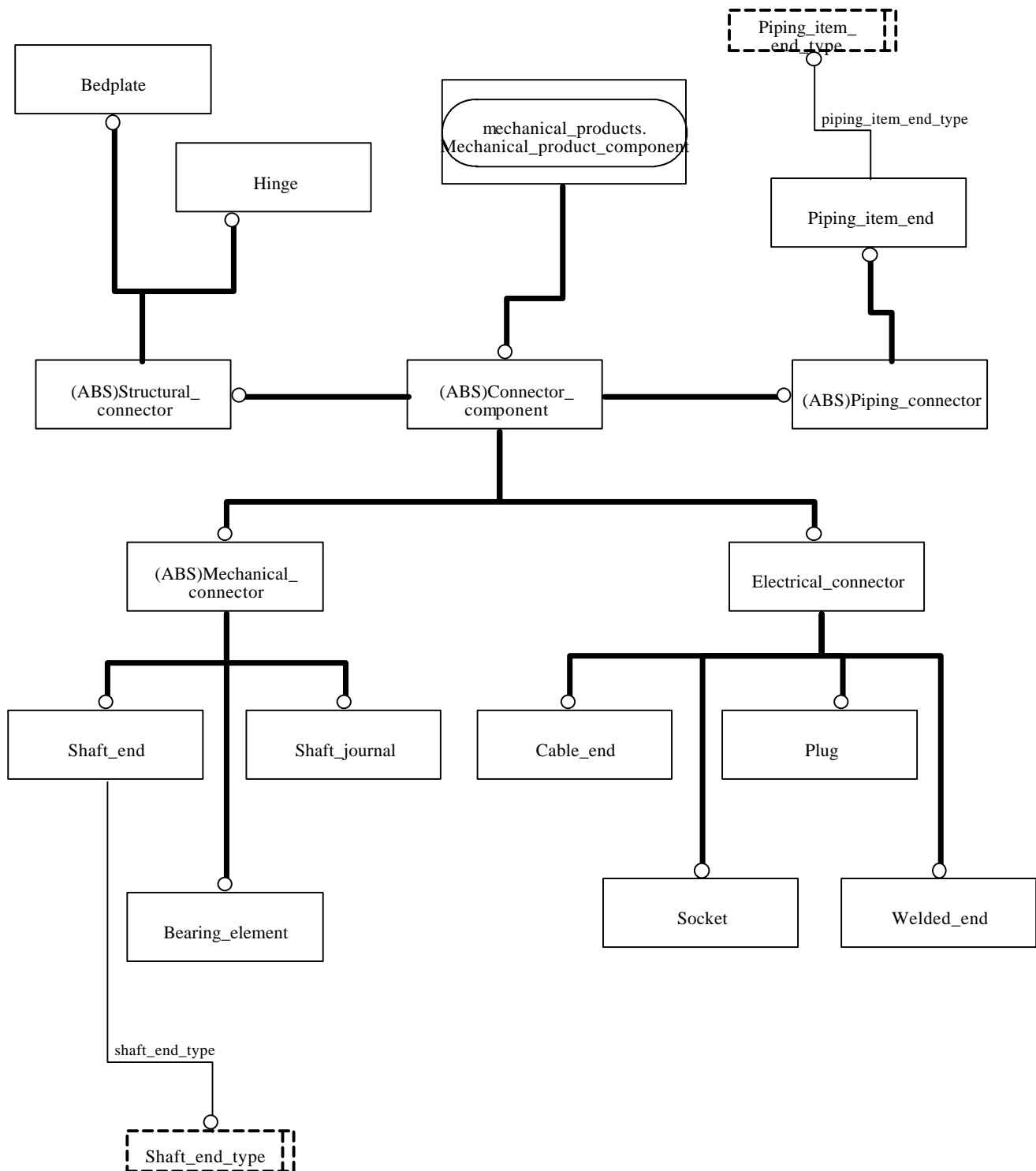
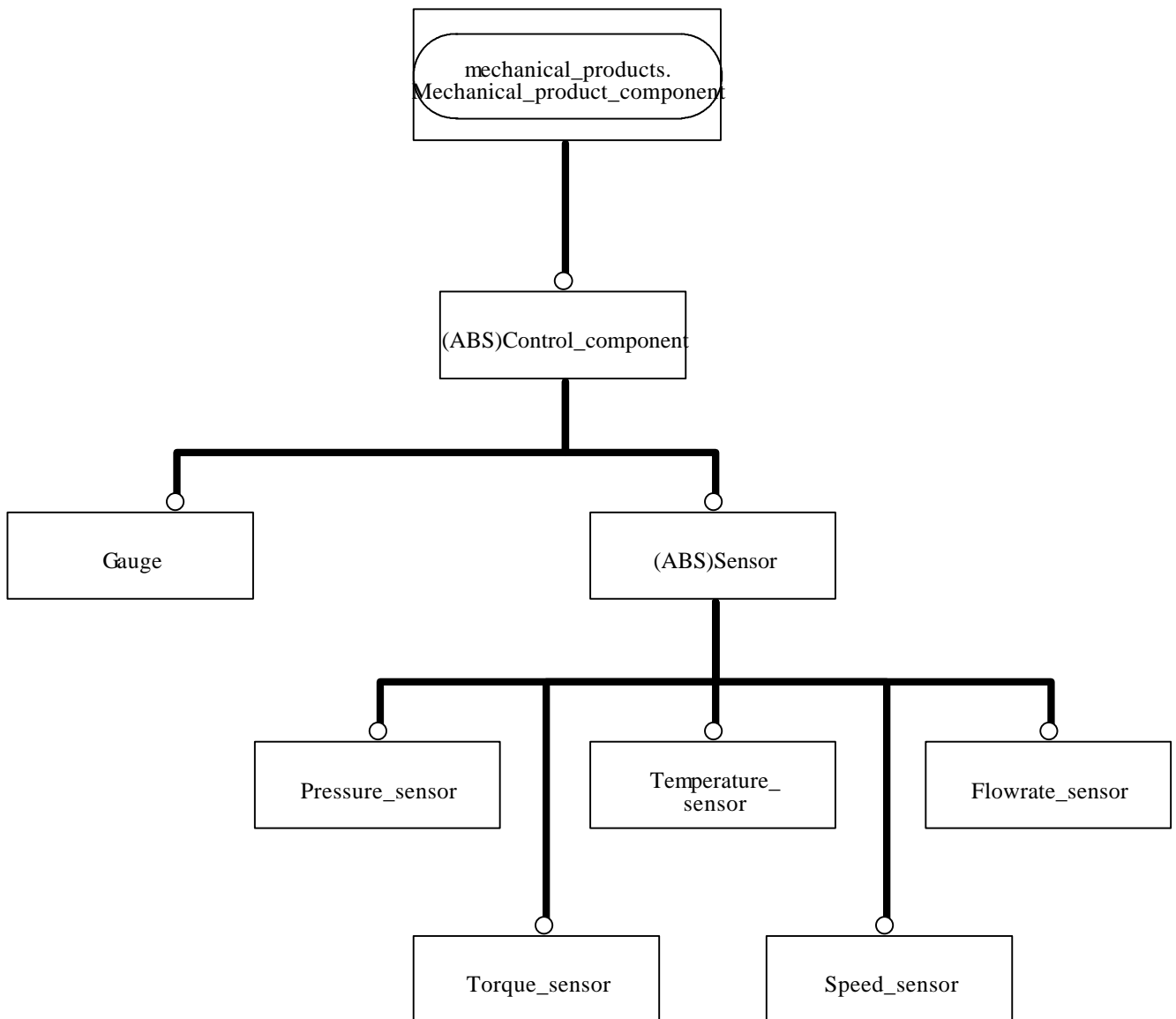


Figure G.2 – Graphical notation of the major aspects of the connecting_components UoF schema (figure 1 of 1)



G.3 - Graphical notation of the major aspects of the connector_components UoF schema (figure 1 of 1)



G.4 - Graphical notation of the major aspects of the control_components UoF schema (figure 1 of 1)

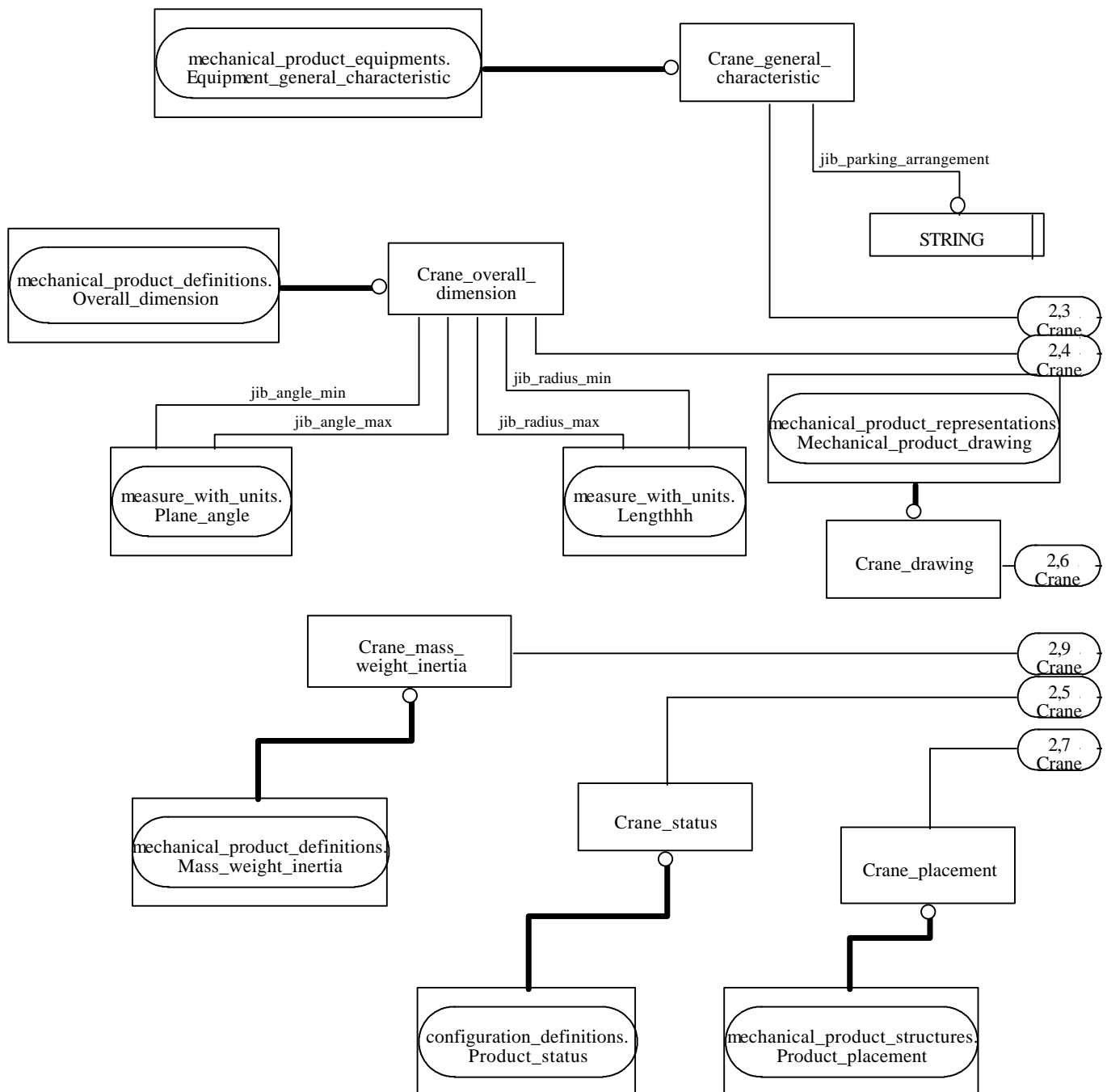


Figure G.5 - Graphical notation of the major aspects of the cranes UoF schema (figure 1 of 3)

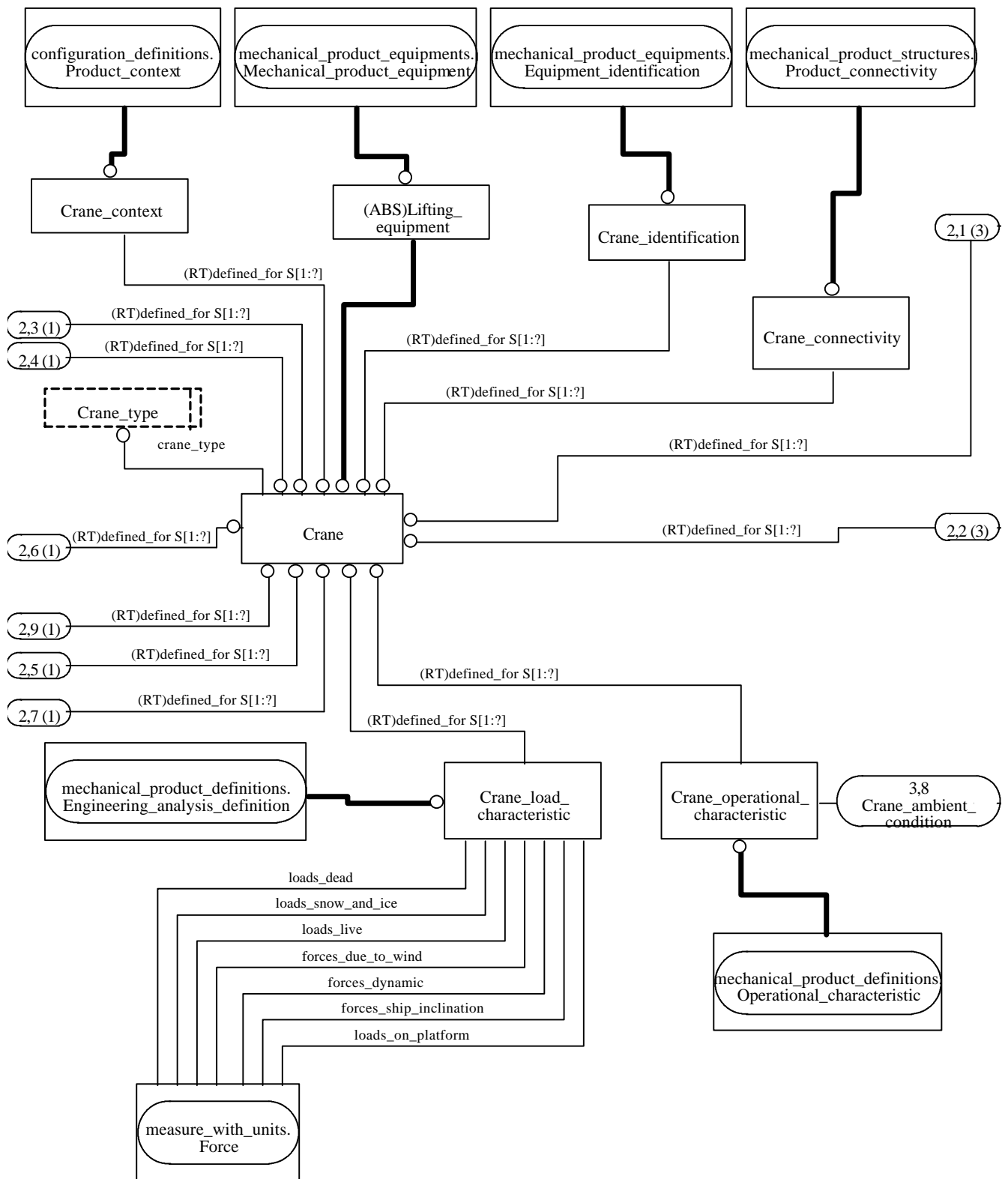


Figure G.6 - Graphical notation of the major aspects of the cranes UoF schema (figure 2 of 3)

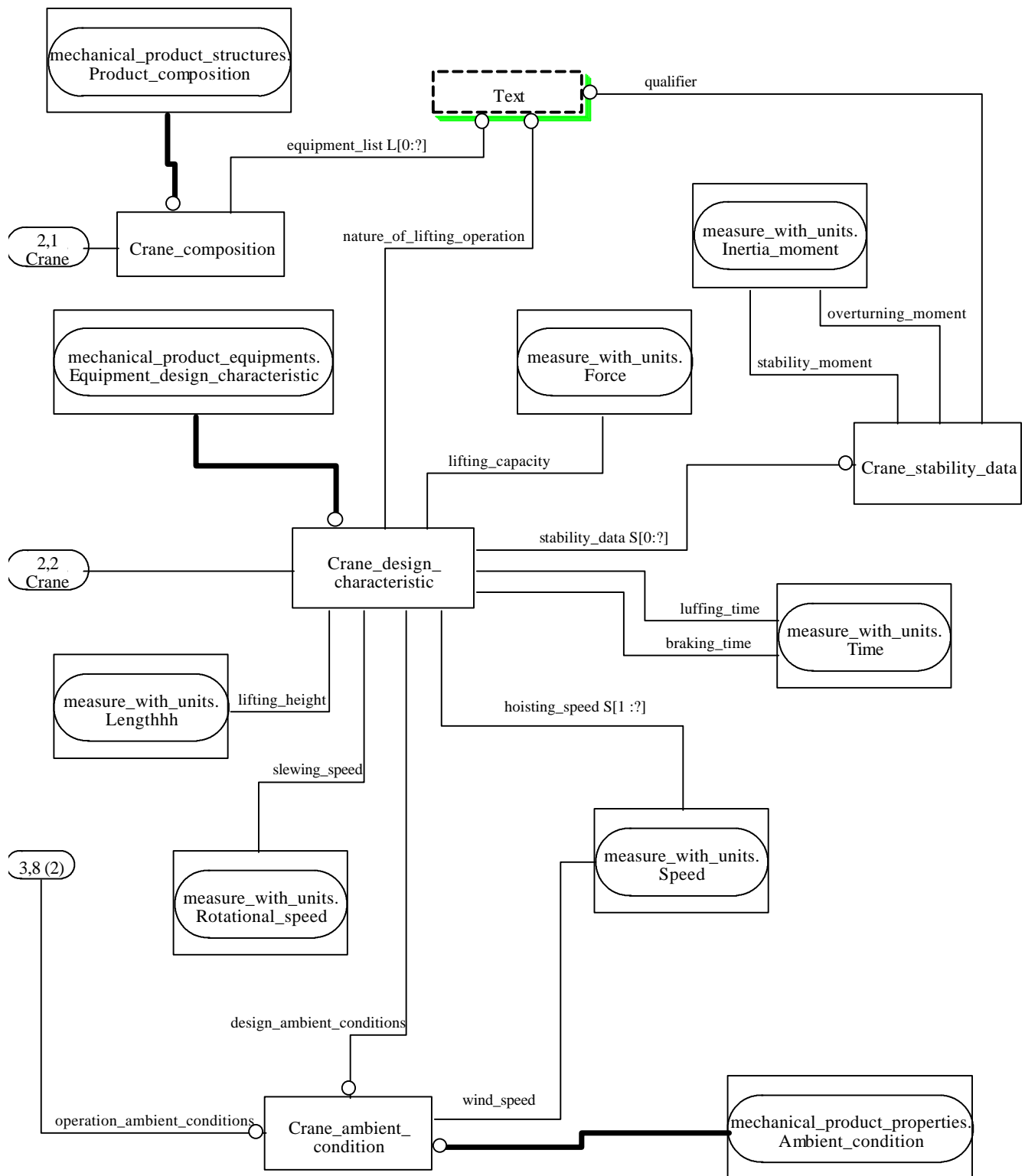


Figure G.7 - Graphical notation of the major aspects of the cranes UoF schema (figure 3 of 3)

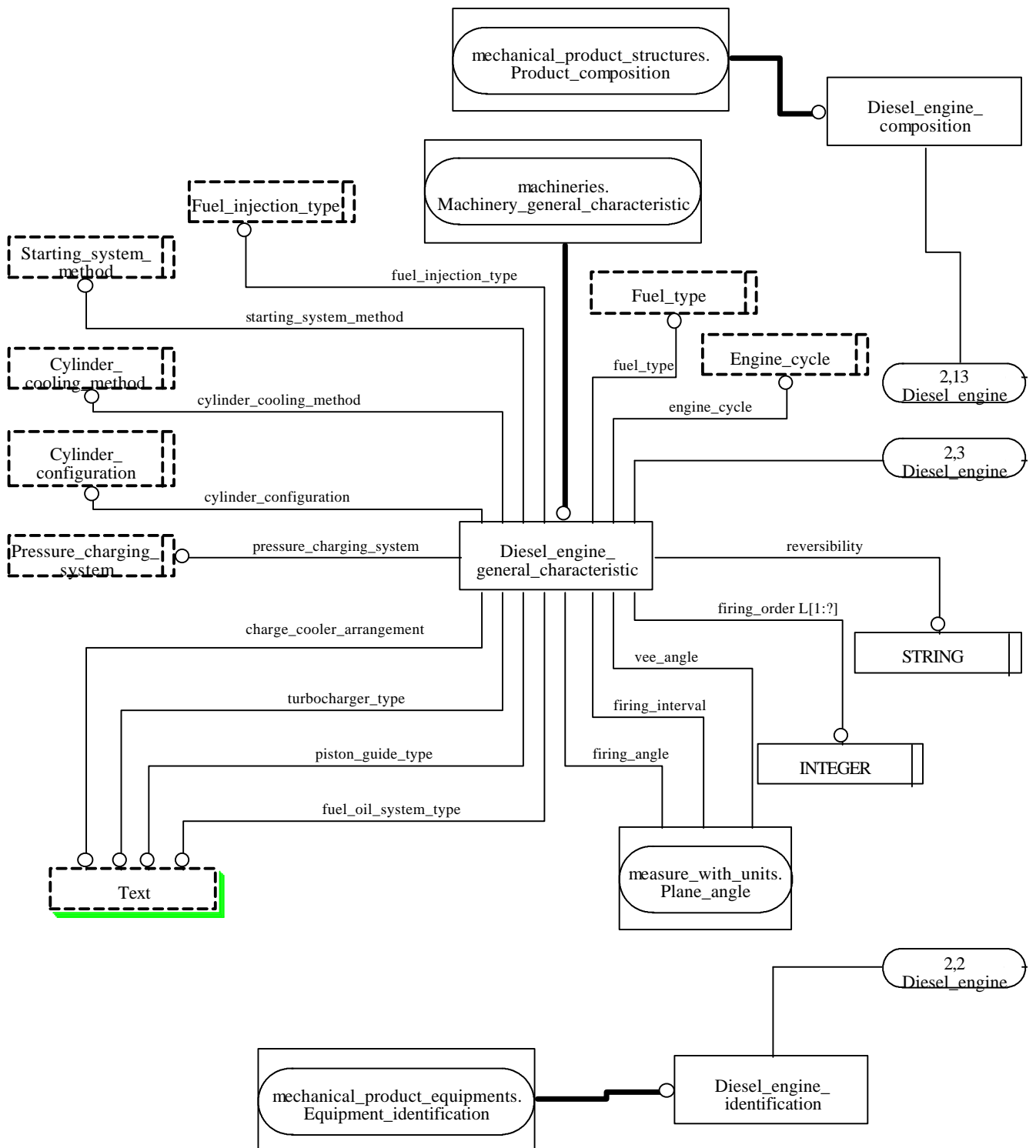


Figure G.8 - Graphical notation of the major aspects of the diesel_engines UoF schema (figure 1 of 4)

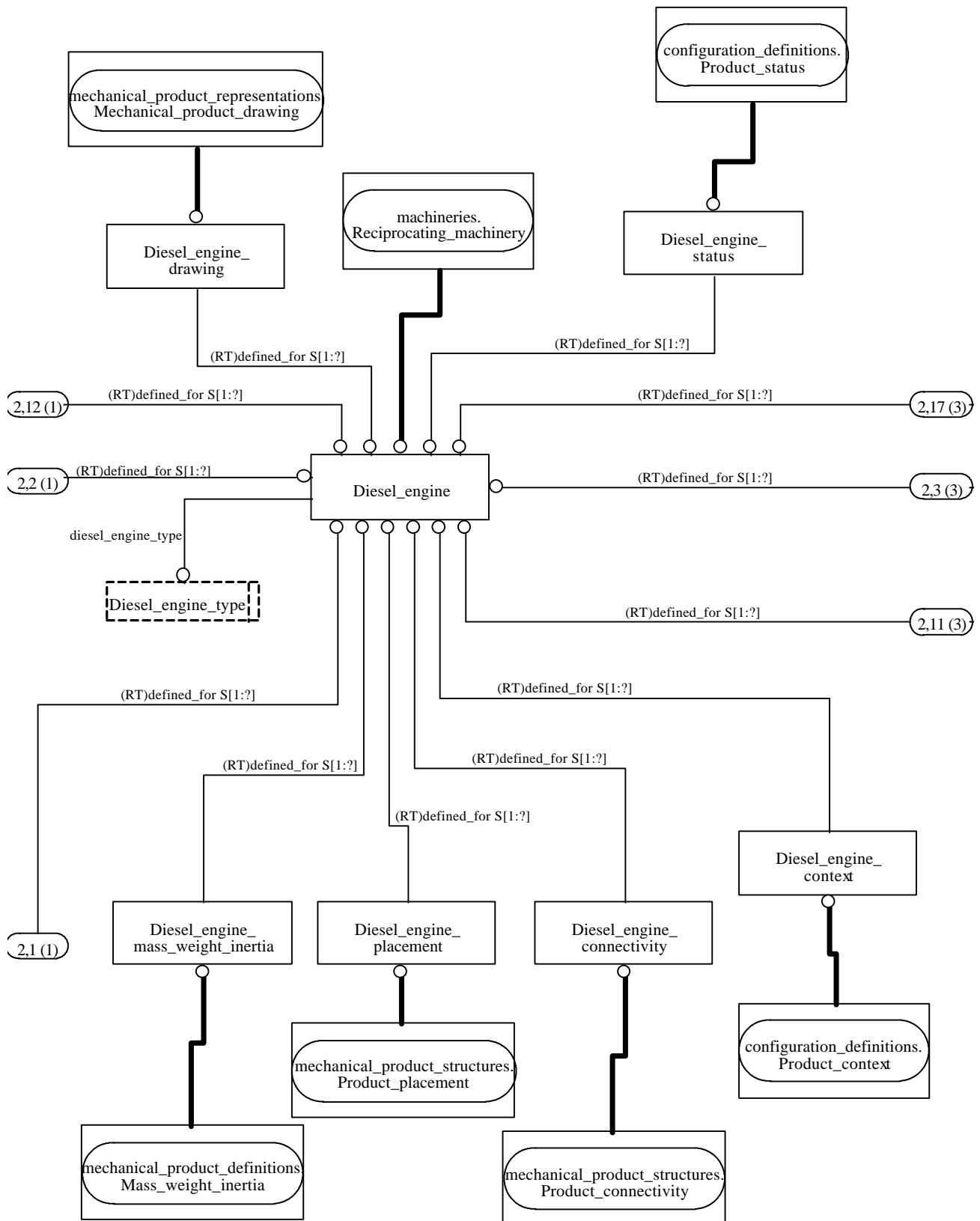


Figure G.9 - Graphical notation of the major aspects of the diesel_engines UoF schema (figure 2 of 4)

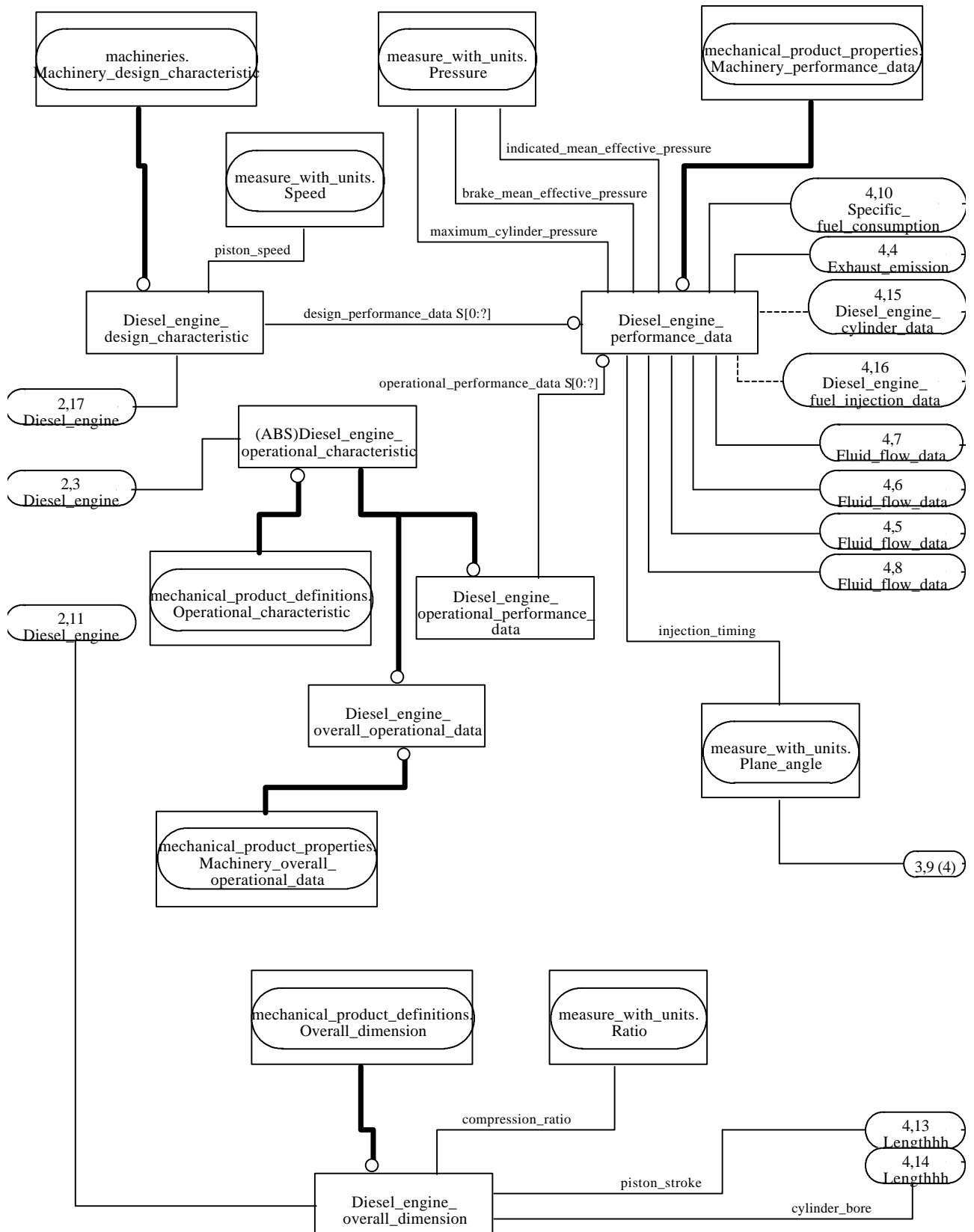


Figure G.10 - Graphical notation of the major aspects of the diesel_engines UoF schema (figure 3 of 4)

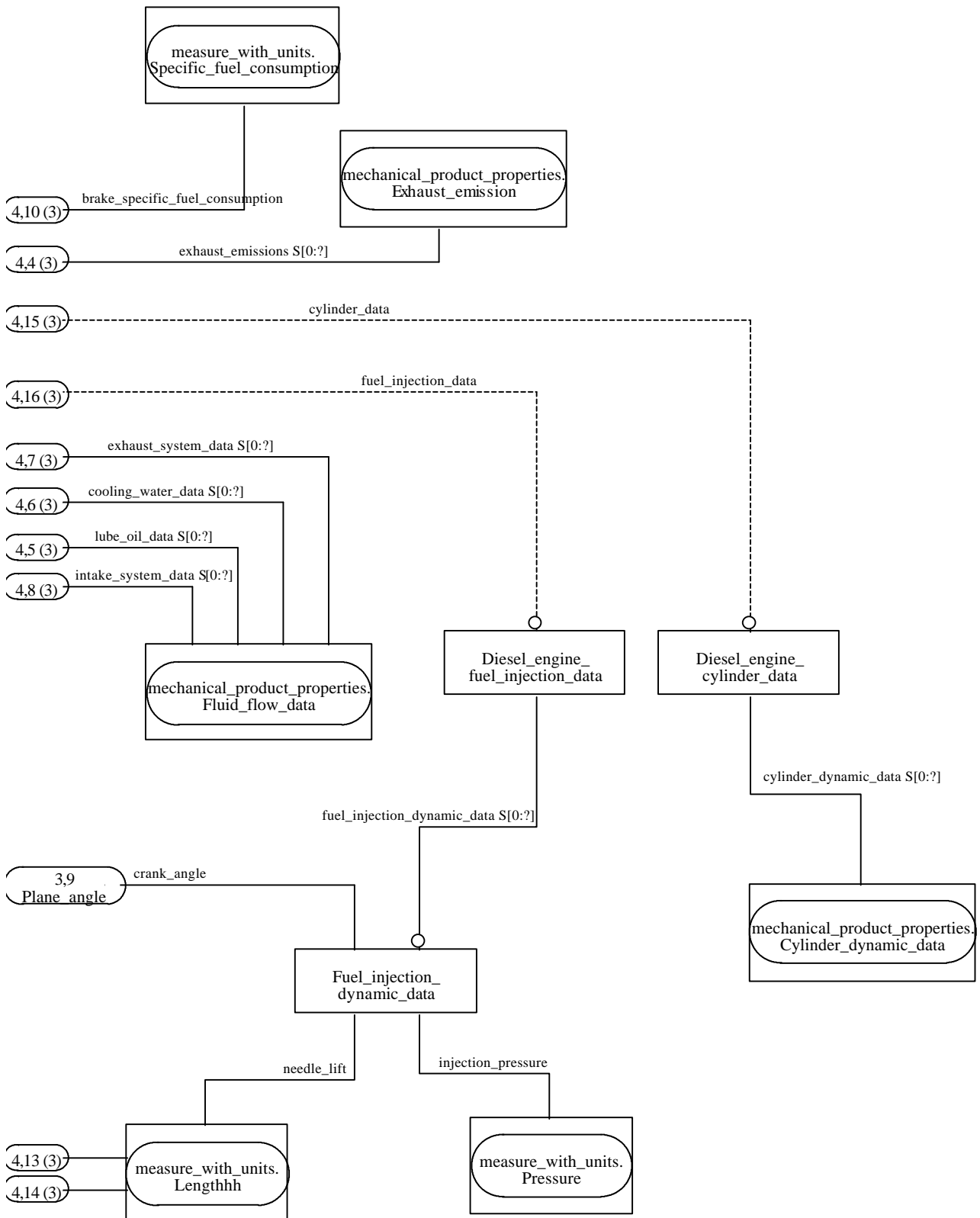


Figure G.11 - Graphical notation of the major aspects of the diesel_engines UoF schema (figure 4 of 4)

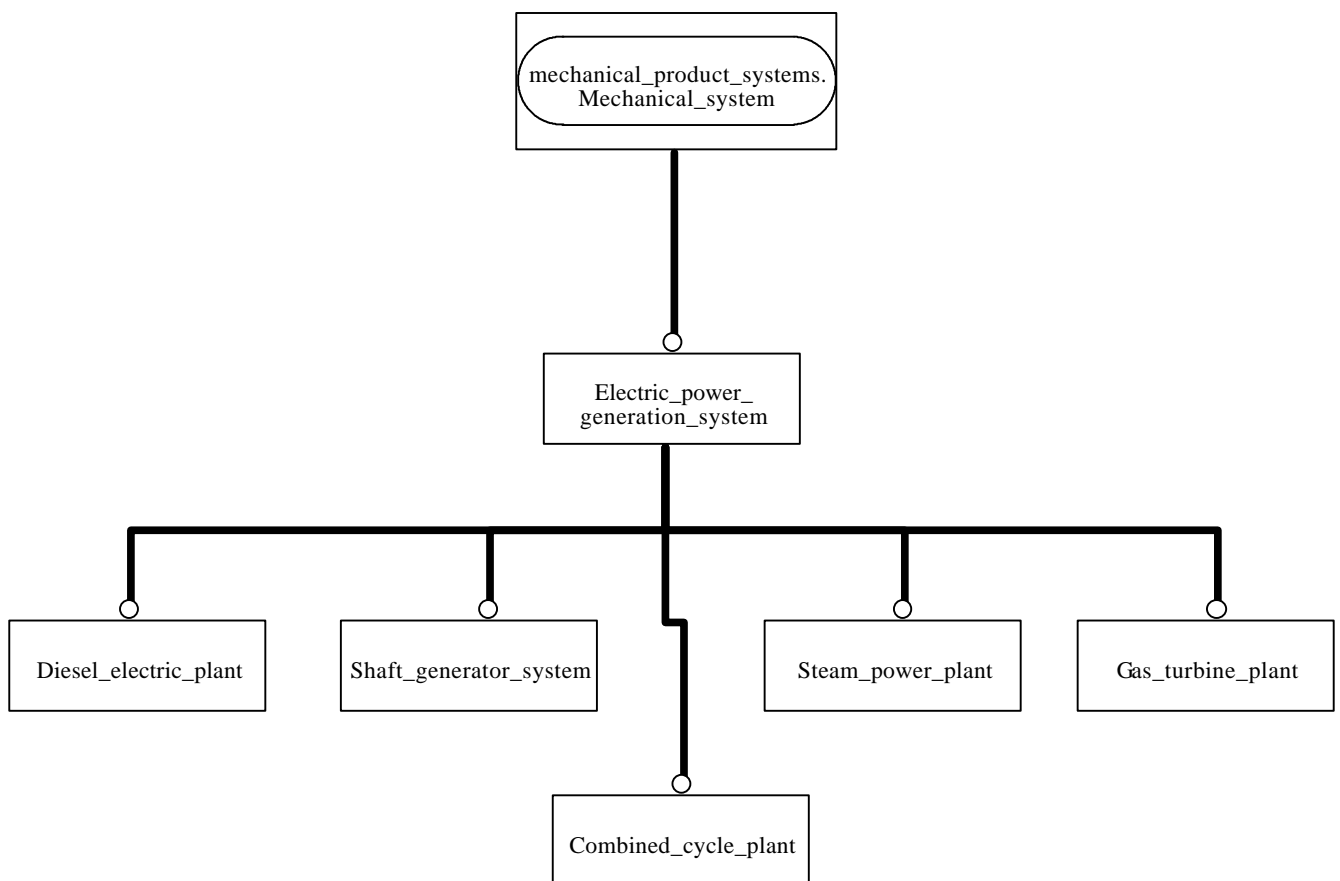


Figure G.12 - Graphical notation of the major aspects of the electric_power_generation_systems UoF schema (figure 1 of 1)

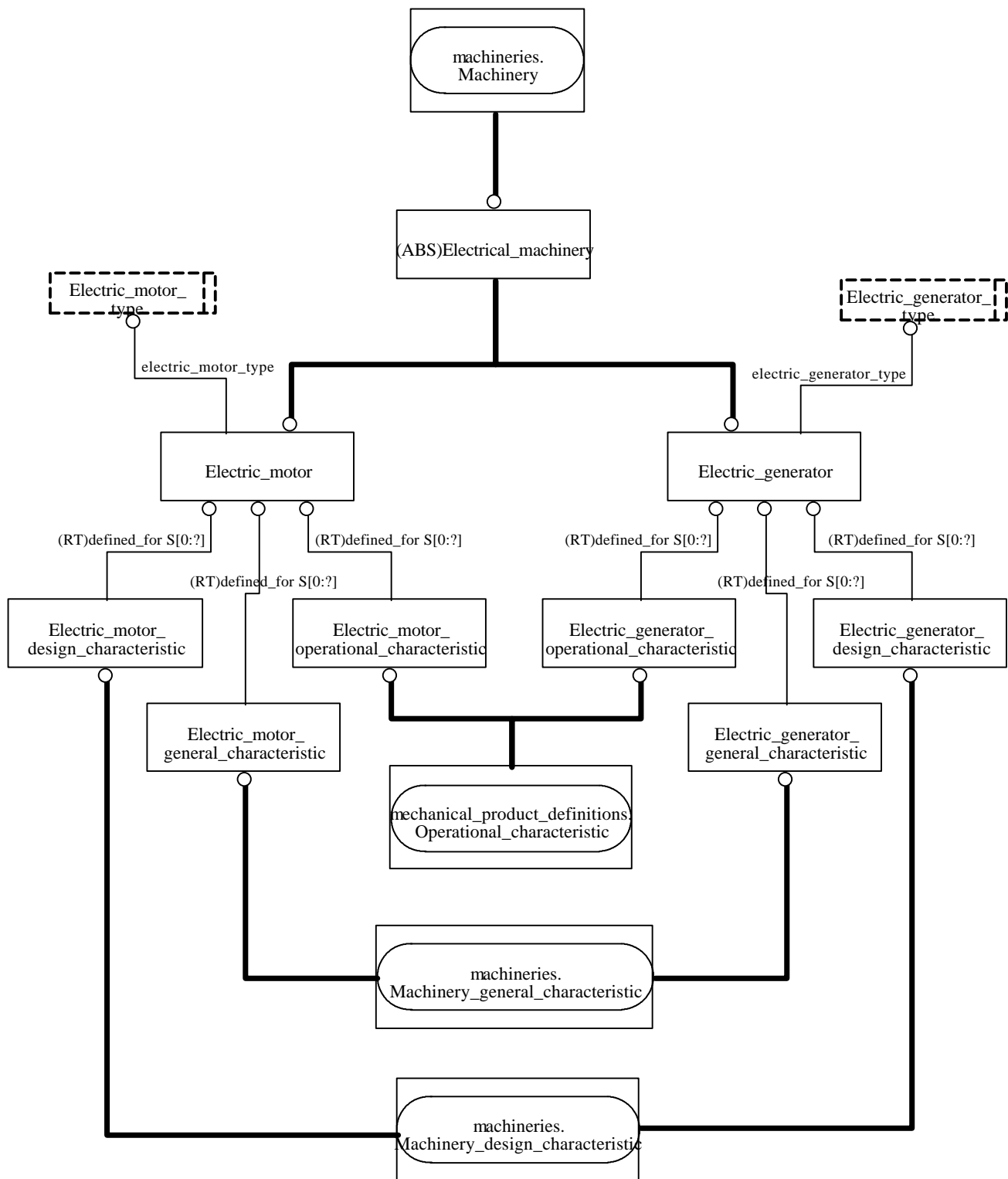


Figure G.13 - Graphical notation of the major aspects of the electrical_machineries UoF schema (figure 1 of 1)

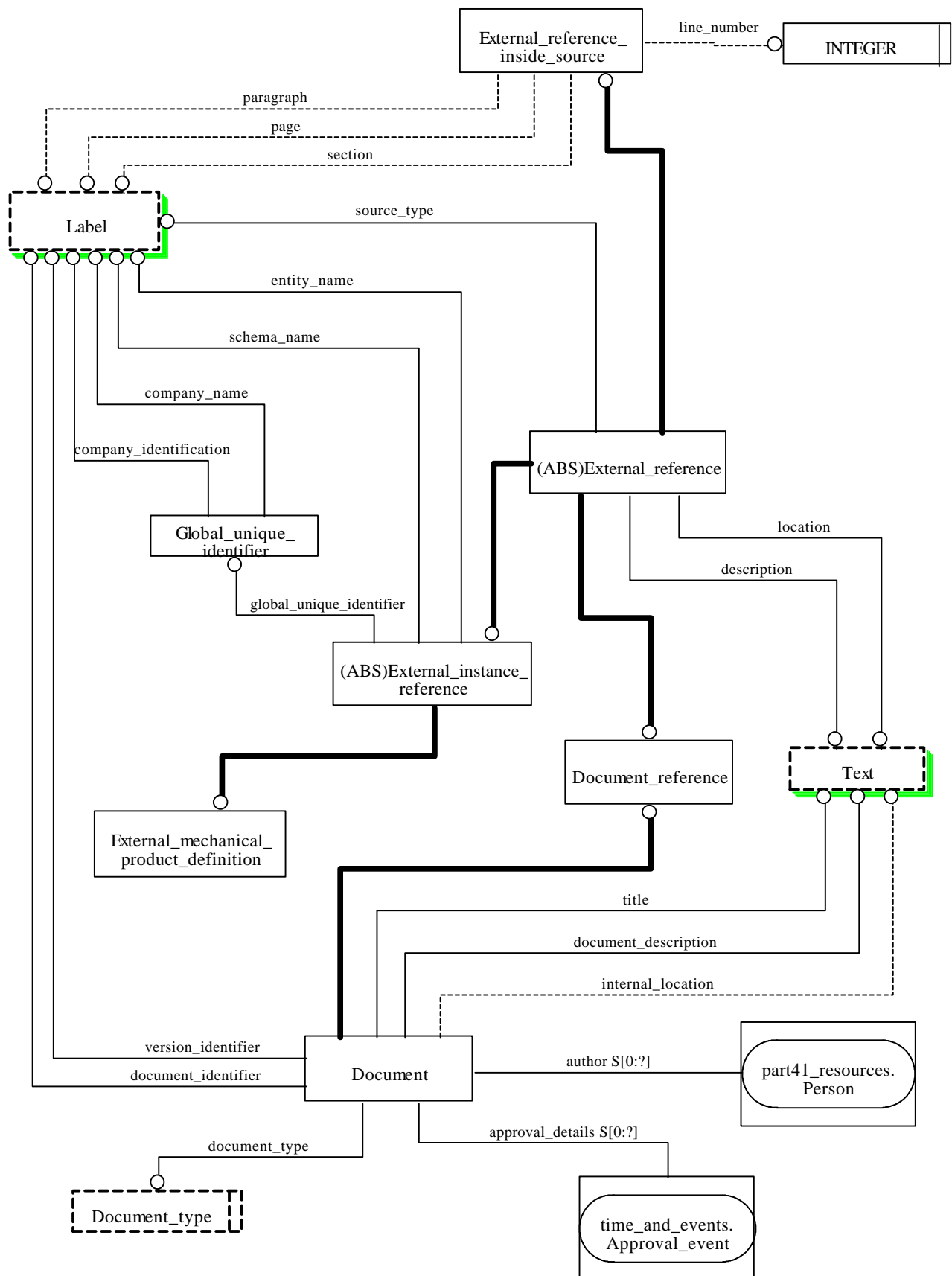


Figure G.14 - Graphical notation of the major aspects of the external_references UoF schema (figure 1 of 1)

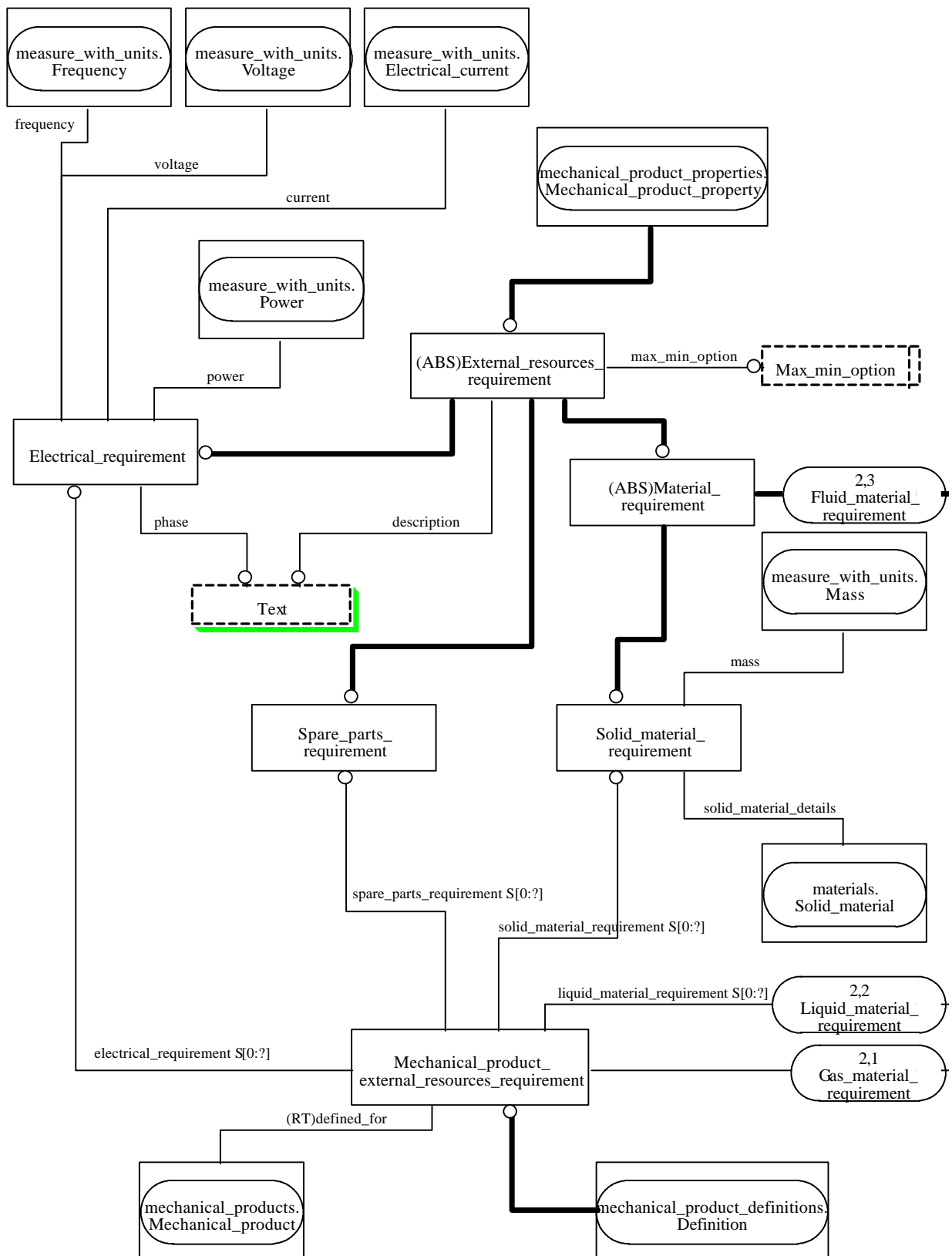


Figure G.15 - Graphical notation of the major aspects of the external_resources_requirements UoF schema (figure 1 of 2)

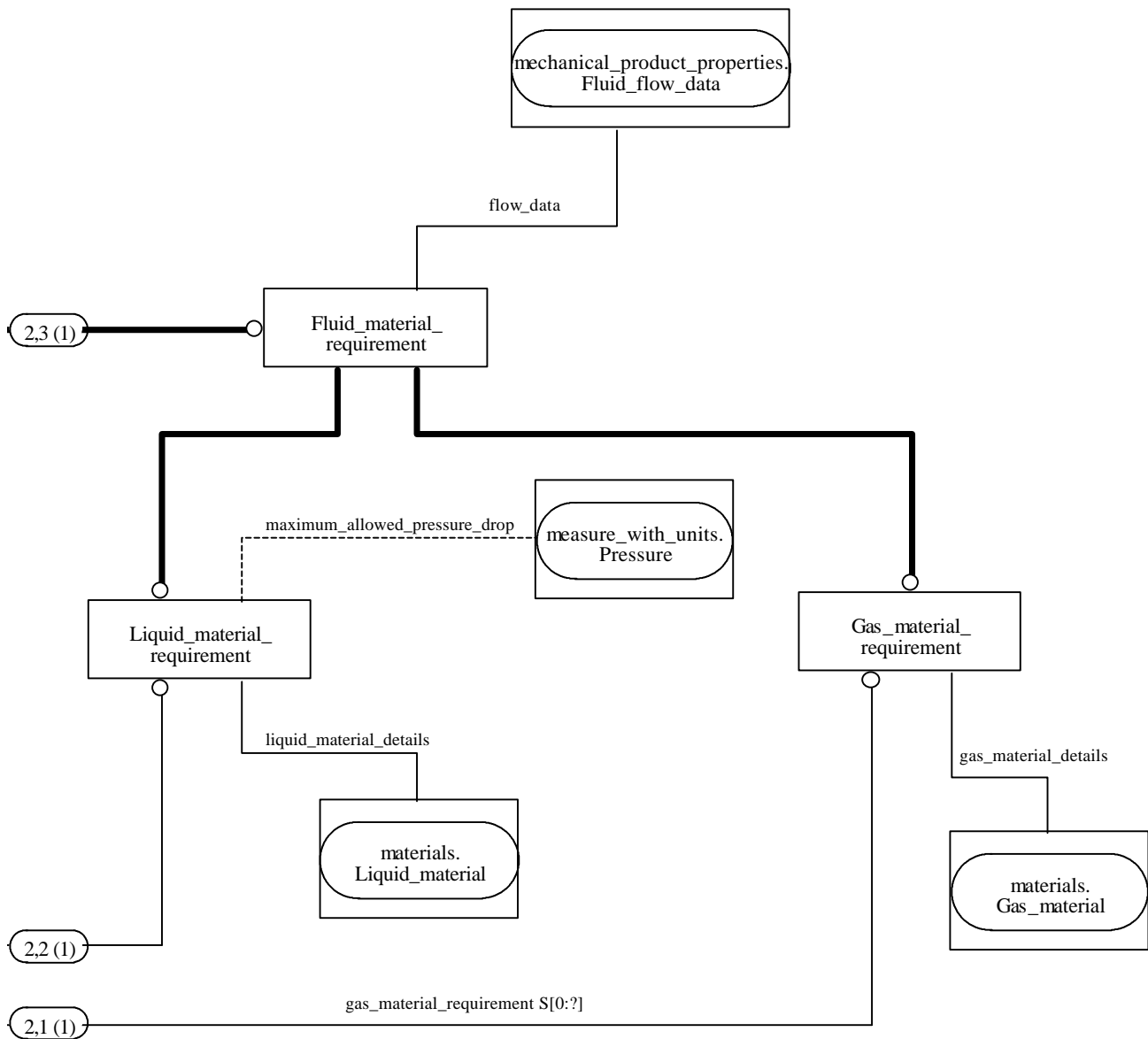


Figure G.16 - Graphical notation of the major aspects of the external_resources_requirements UoF schema (figure 2 of 2)

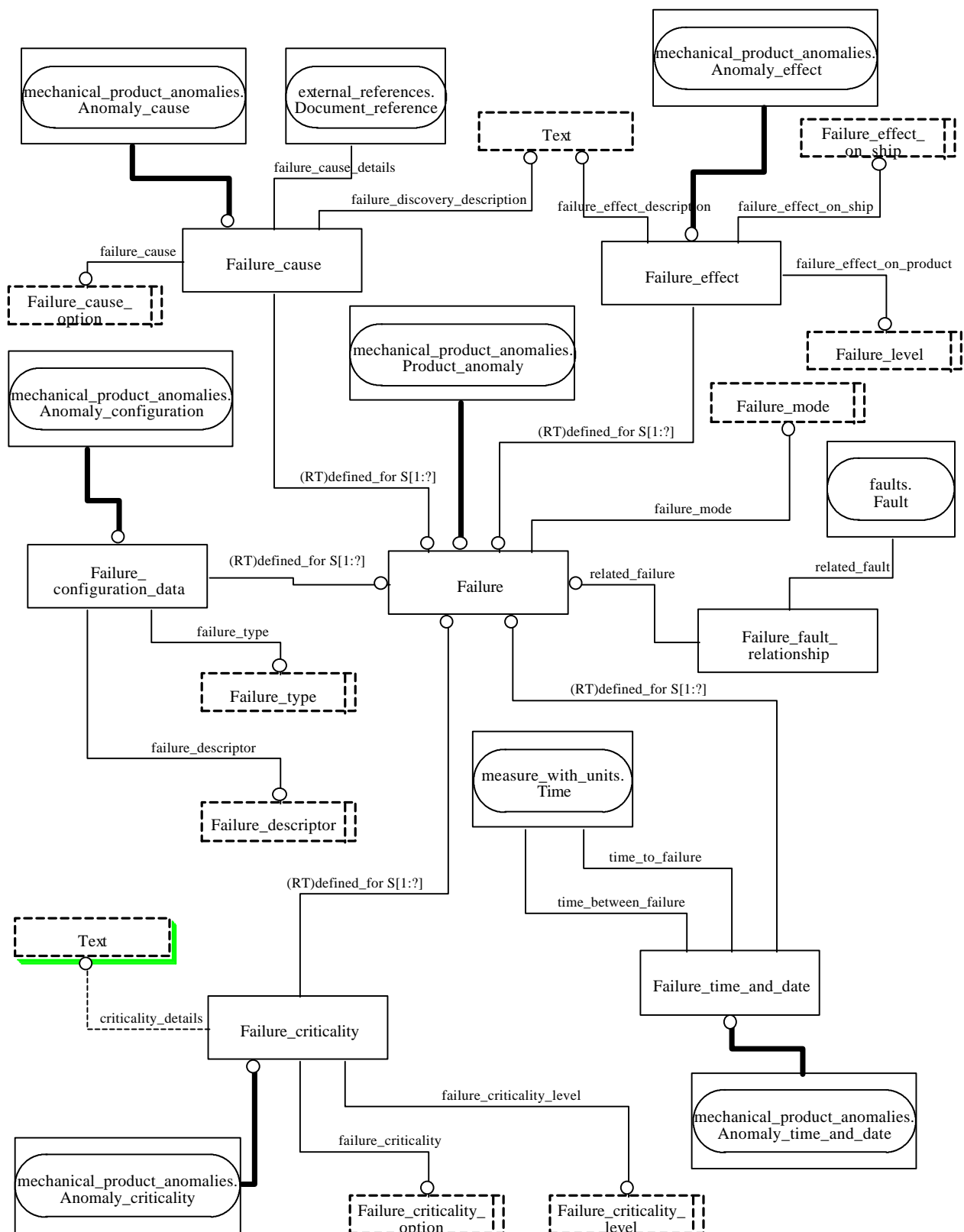


Figure G.17 - Graphical notation of the major aspects of the failures UoF schema (figure 1 of 1)

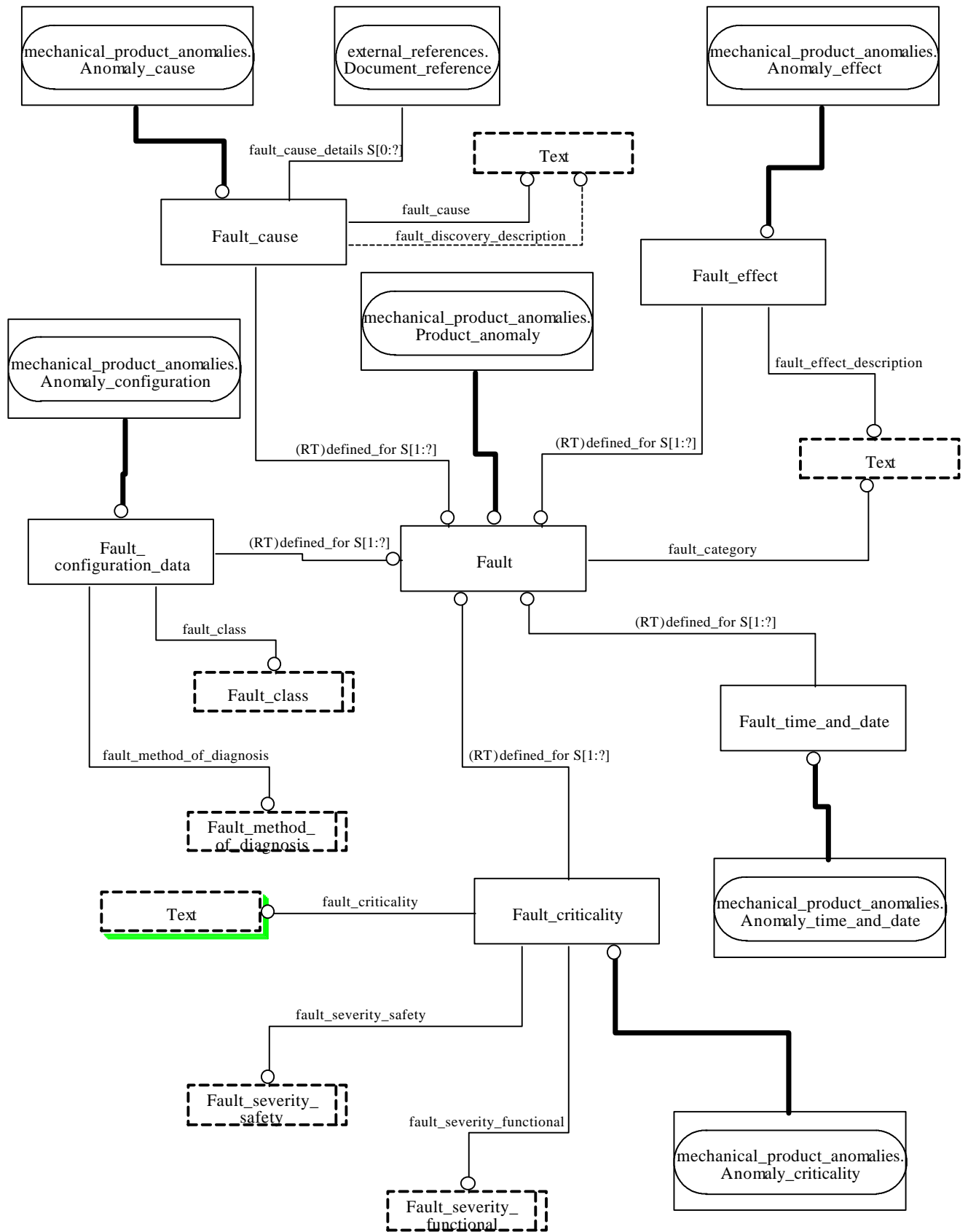


Figure G.18 - Graphical notation of the major aspects of the faults UoF schema (figure 1 of 1)

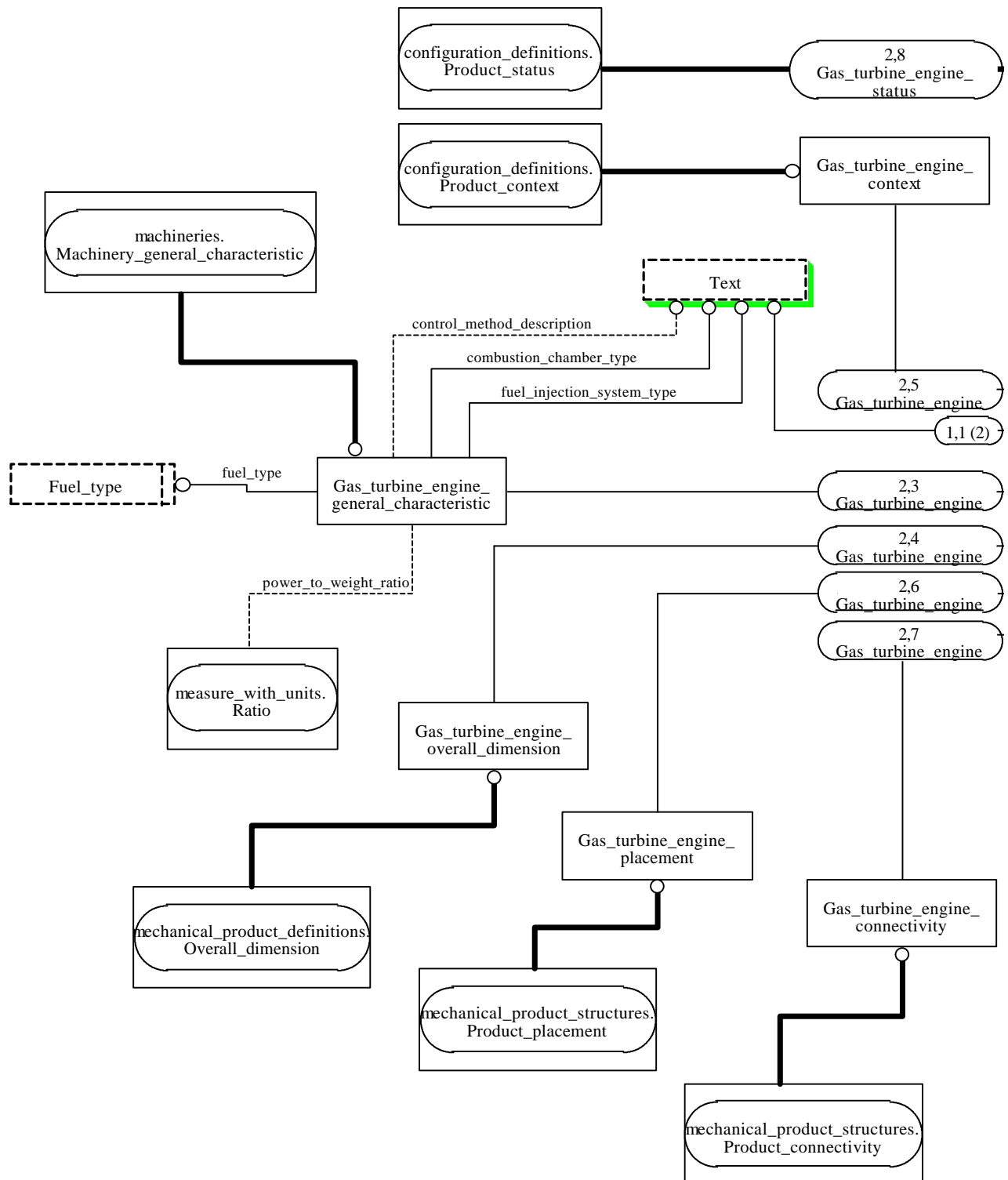


Figure G.19 - Graphical notation of the major aspects of the gas_turbine_engines UoF schema (figure 1 of 3)

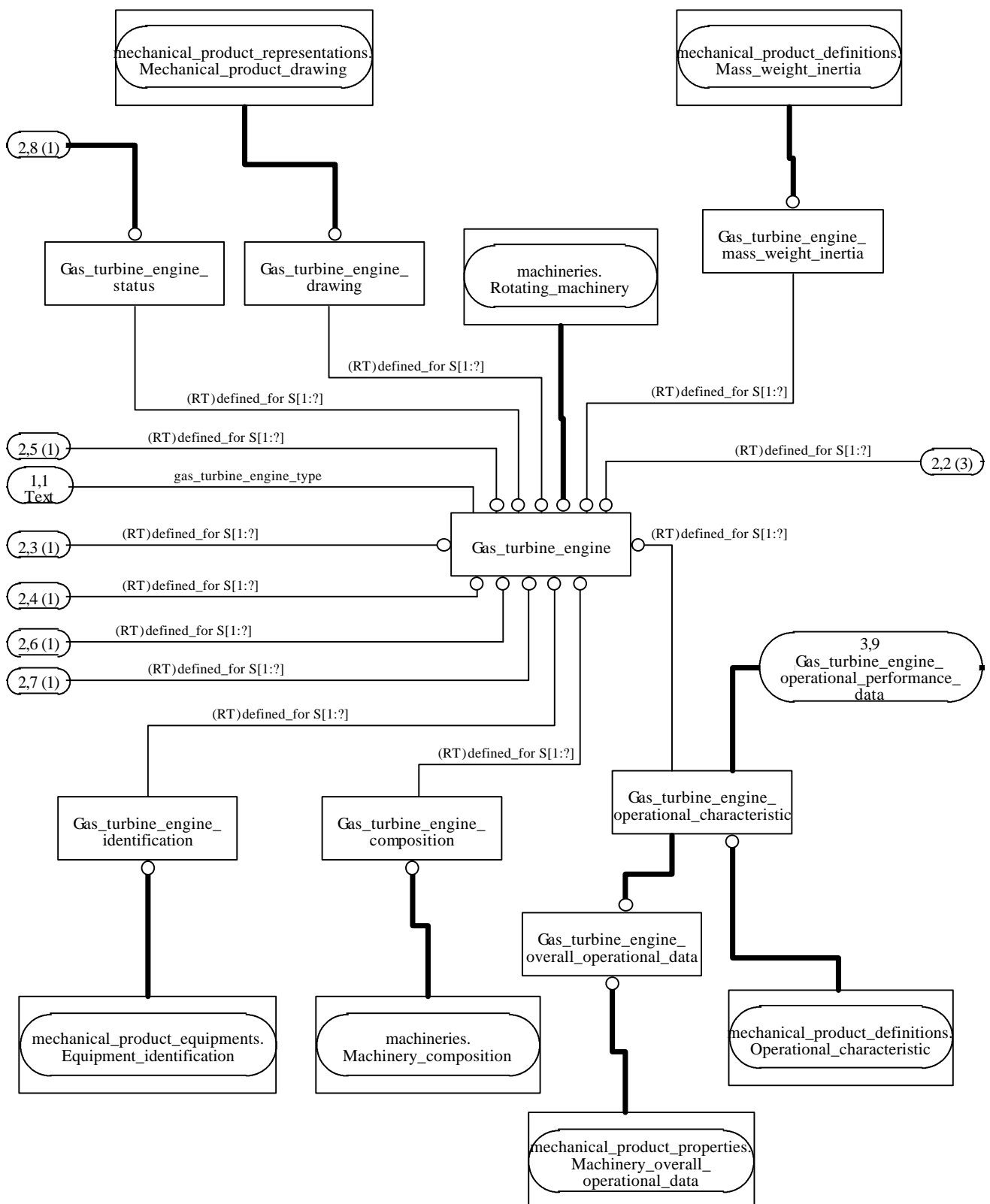


Figure G.20 - Graphical notation of the major aspects of the gas_turbine_engines UoF schema (figure 2 of 3)

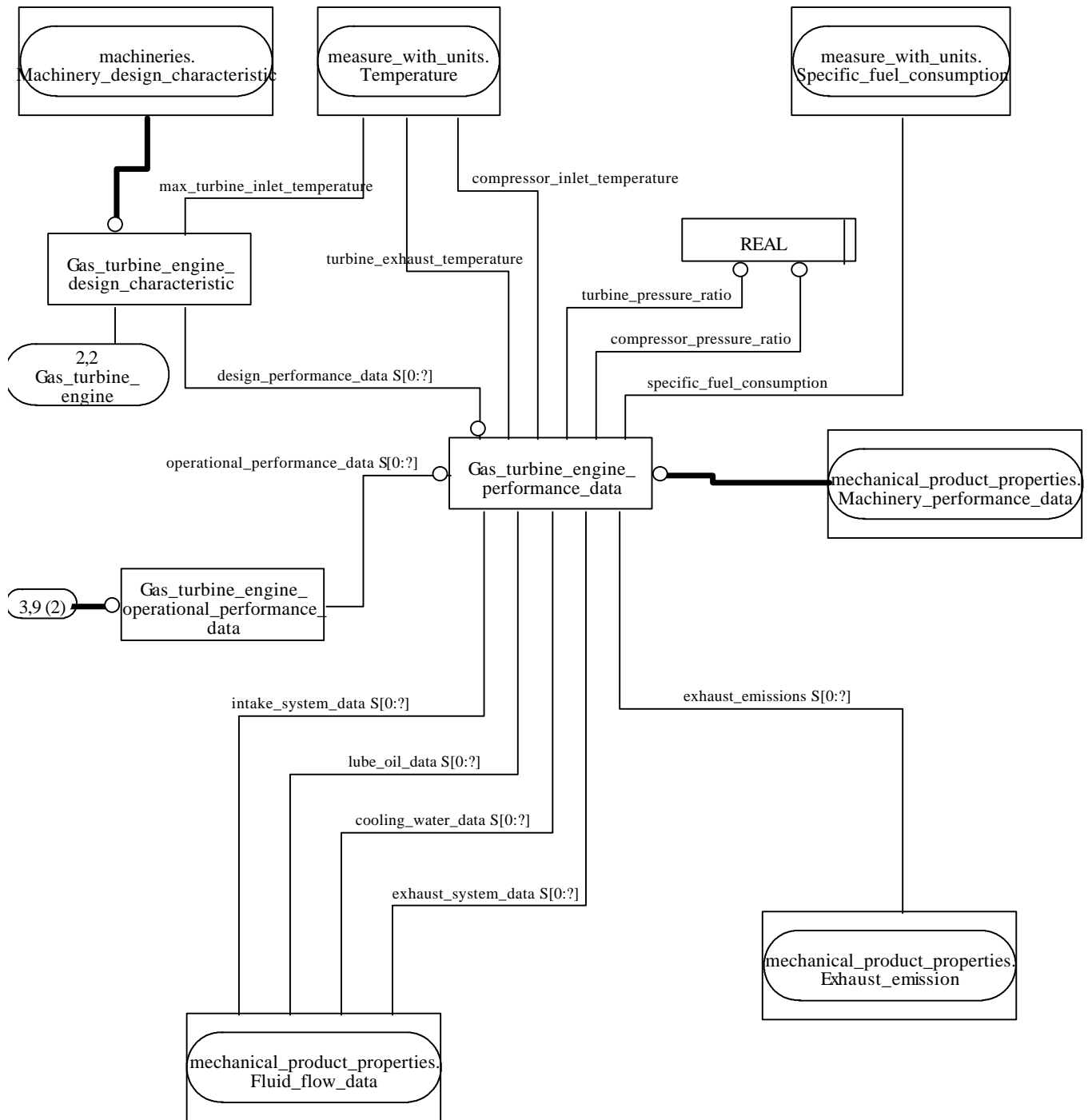


Figure G.21 - Graphical notation of the major aspects of the `gas_turbine_engines` UoF schema (figure 3 of 3)

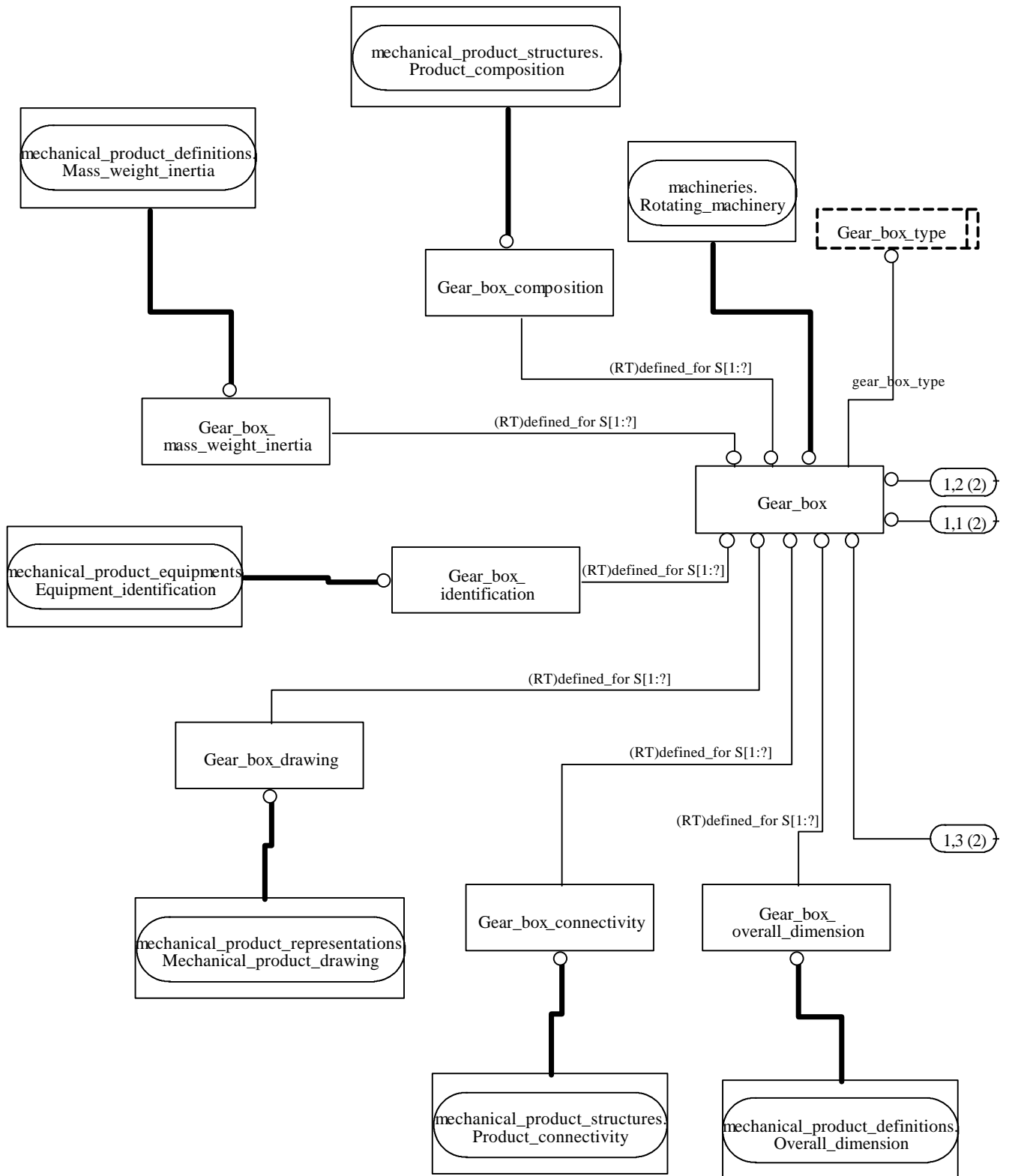


Figure G.22 - Graphical notation of the major aspects of the gear_boxes UoF schema (figure 1 of 2)

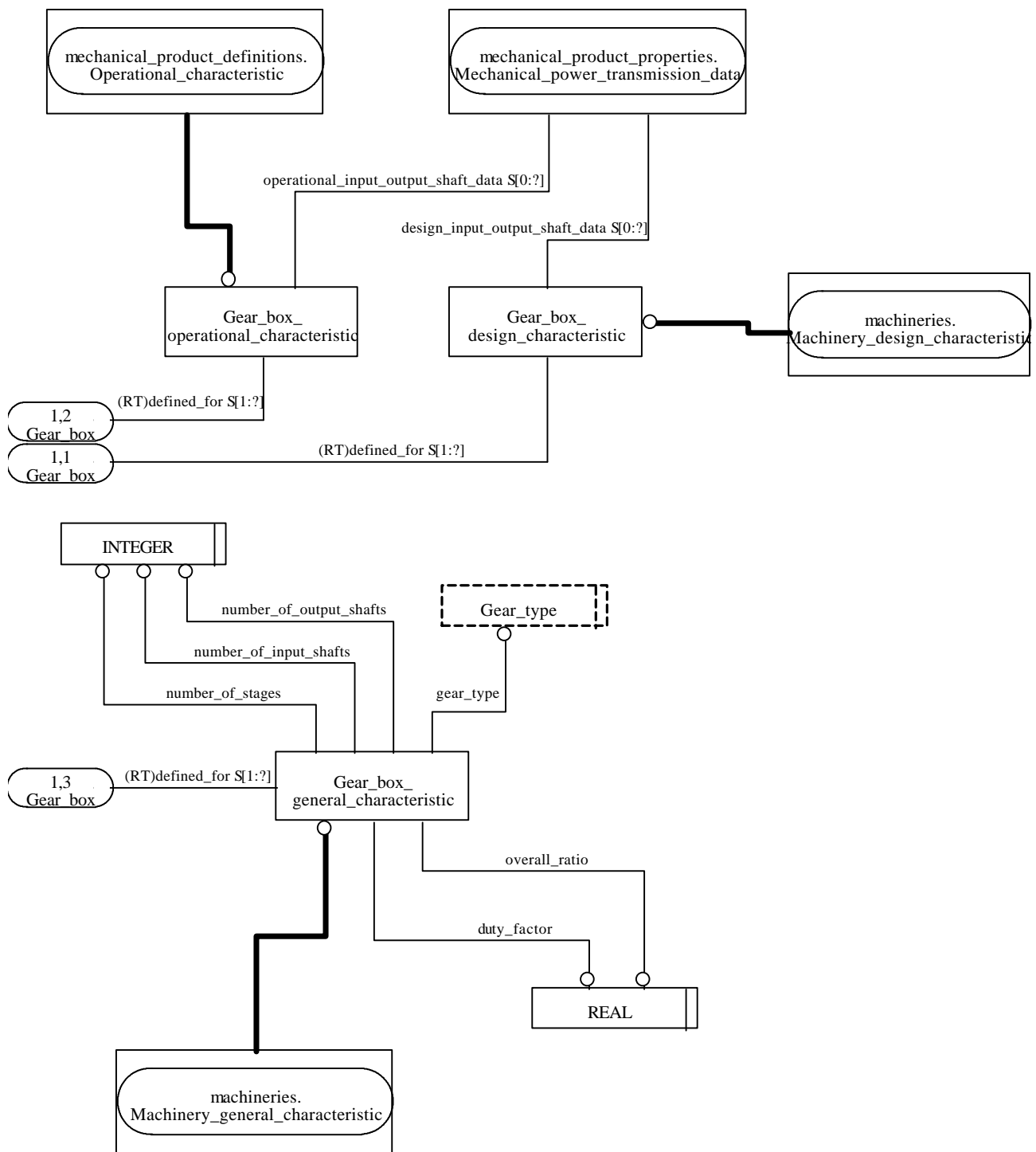


Figure G.23 - Graphical notation of the major aspects of the gear_boxes UoF schema (figure 2 of 2)

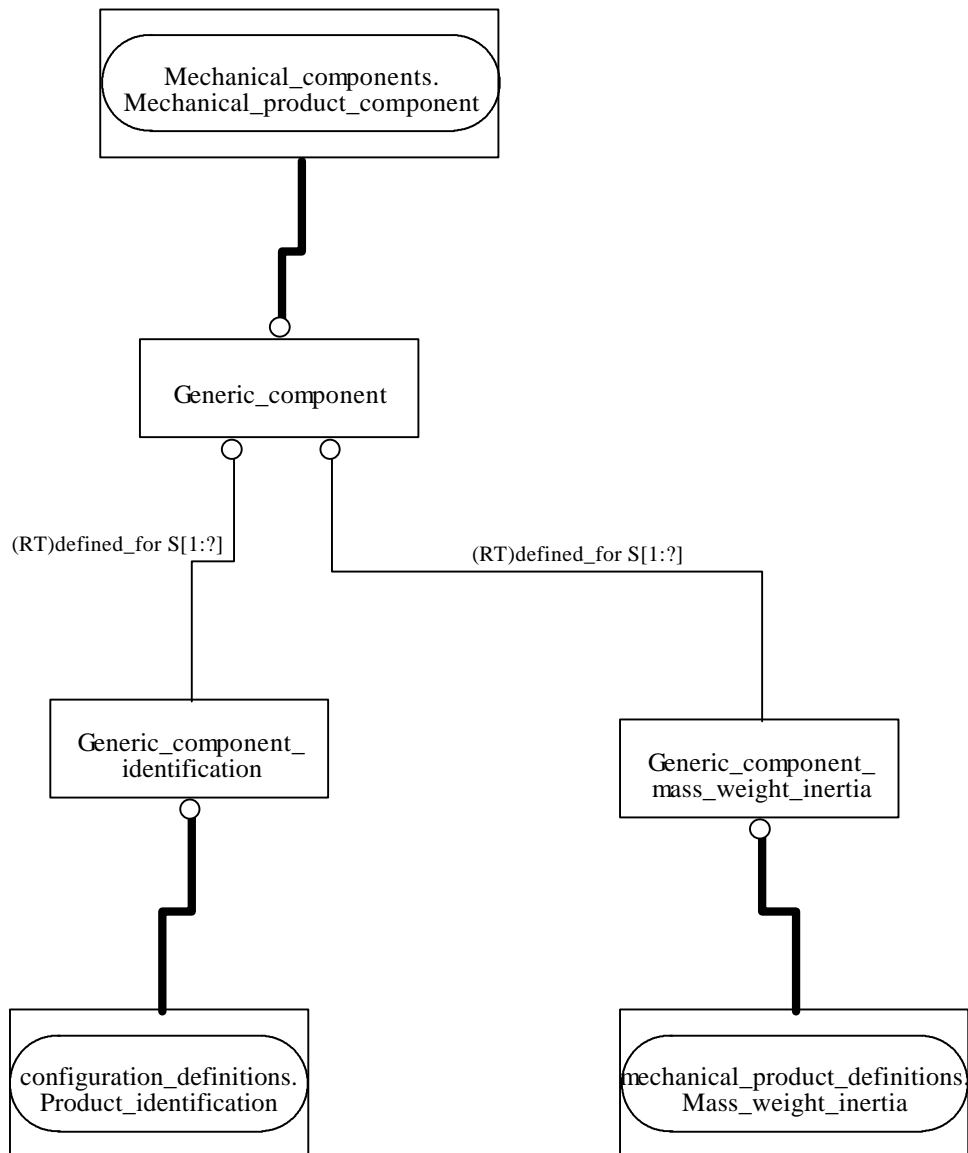


Figure G.24 - Graphical notation of the major aspects of the generic_components UoF schema (figure 1 of 1)

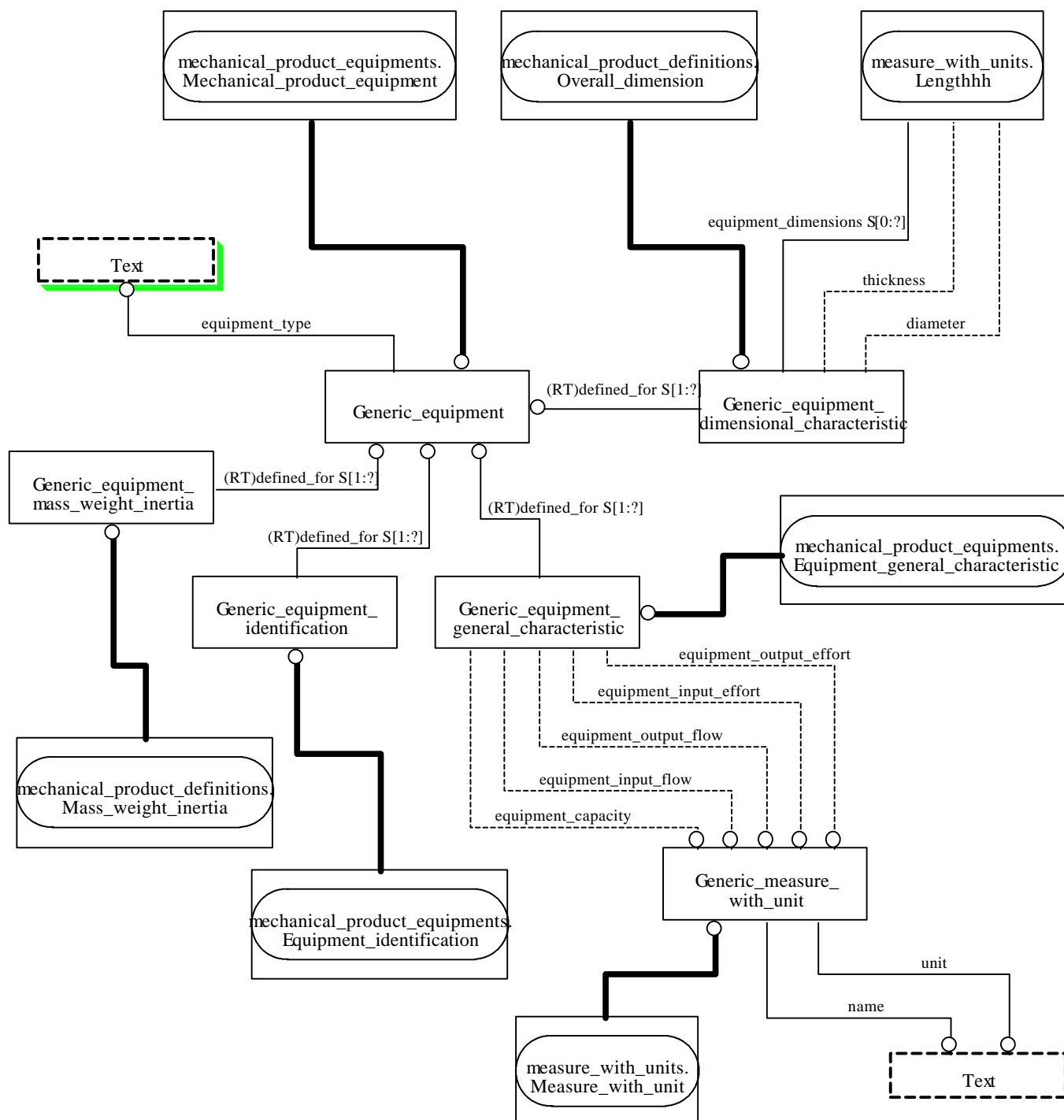


Figure G.25 - Graphical notation of the major aspects of the generic equipments UoF schema (figure 1 of 1)

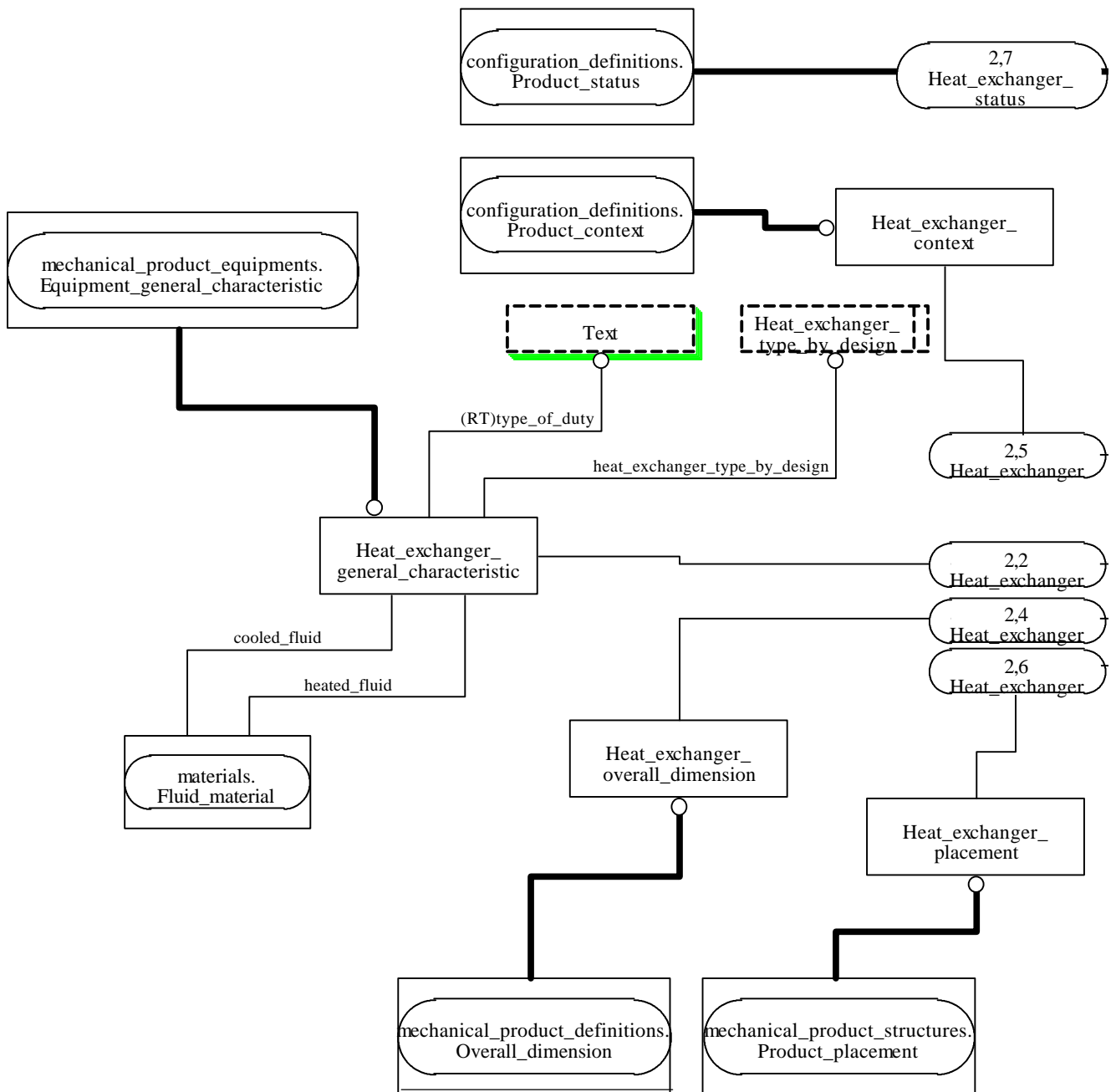


Figure G.26 - Graphical notation of the major aspects of the heat_exchangers UoF schema (figure 1 of 3)

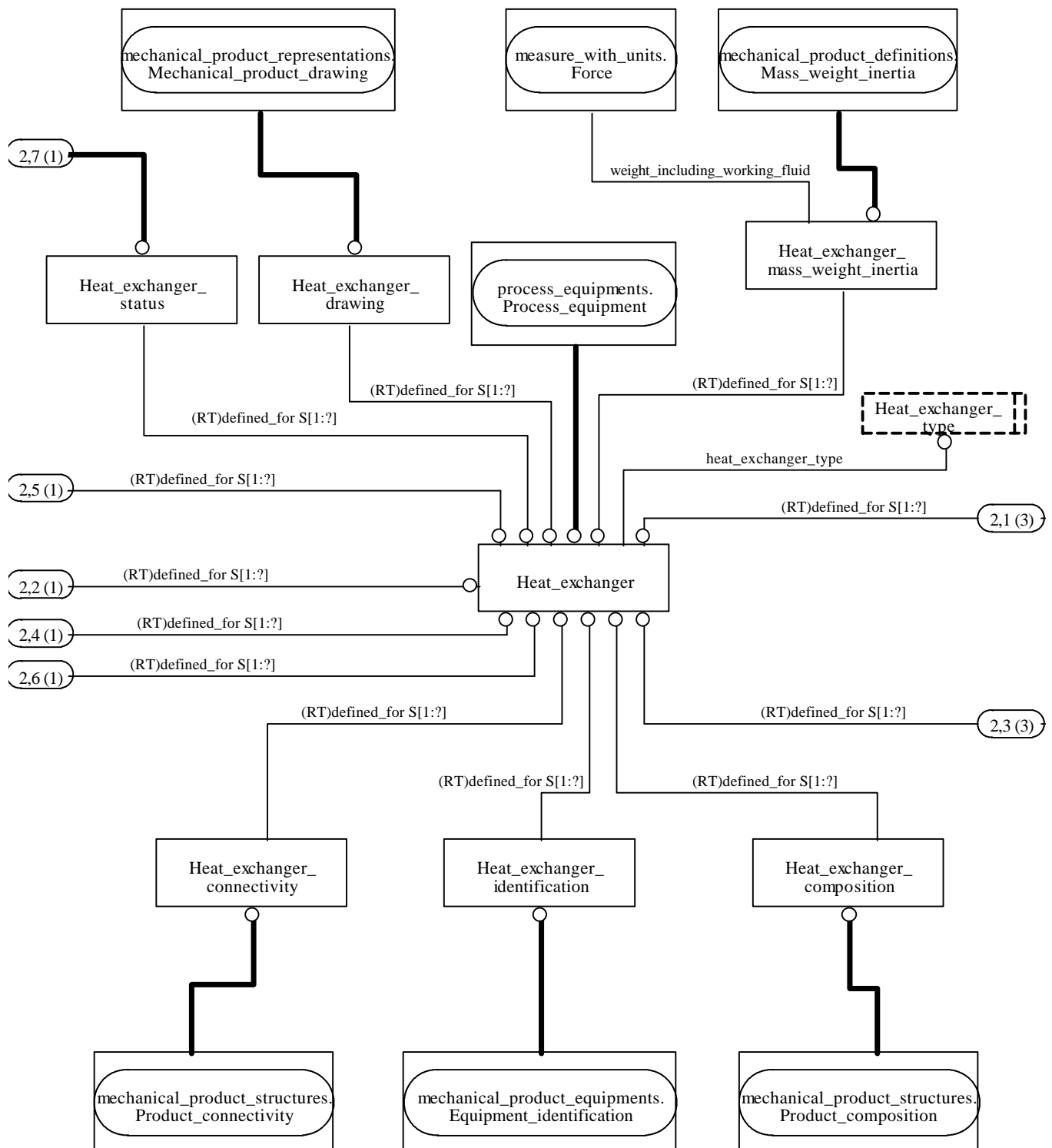


Figure G.27- Graphical notation of the major aspects of the Heat_exchangers UoF schema (figure 2 of 3)

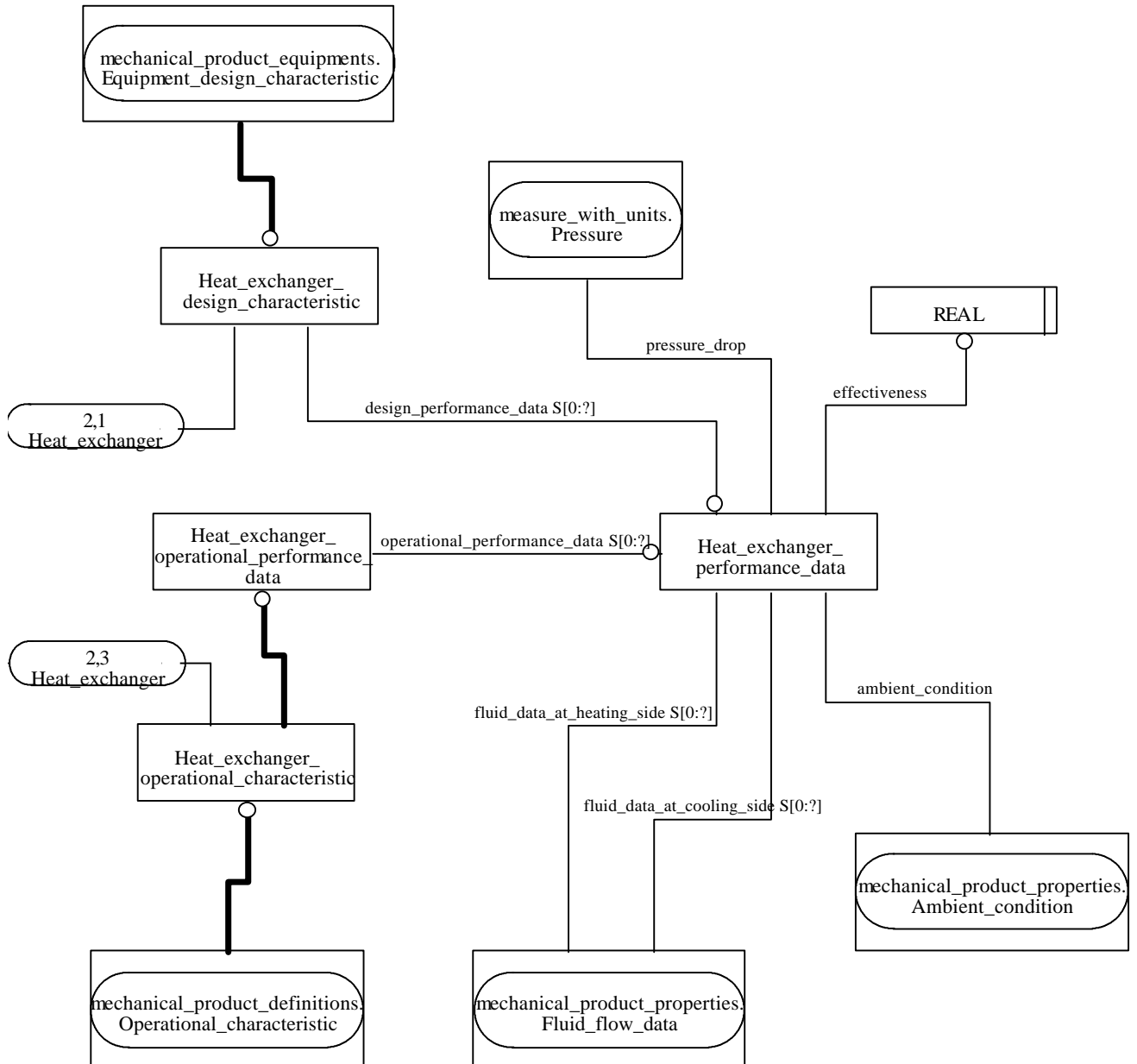


Figure G.28 - Graphical notation of the major aspects of the heat_exchangers UoF schema (figure 3 of 3)

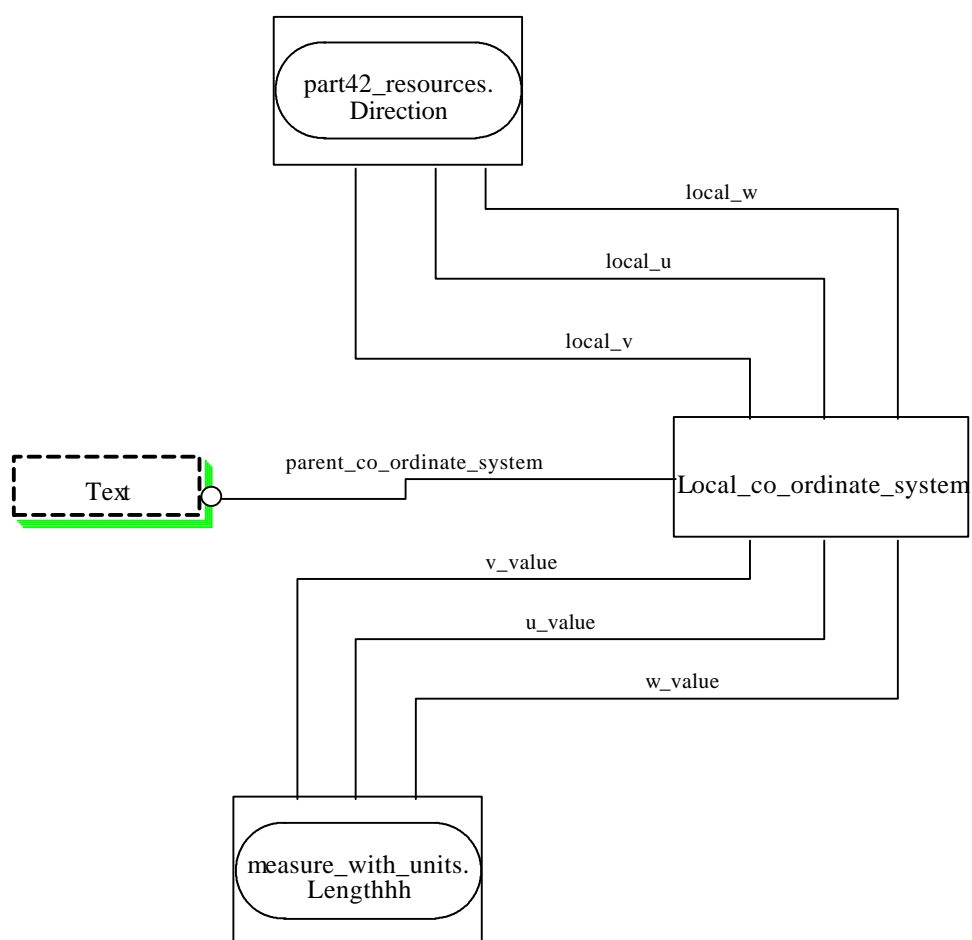


Figure G.29 - Graphical notation of the major aspects of the local_co_ordinate_systems UoF schema (figure 1 of 1)

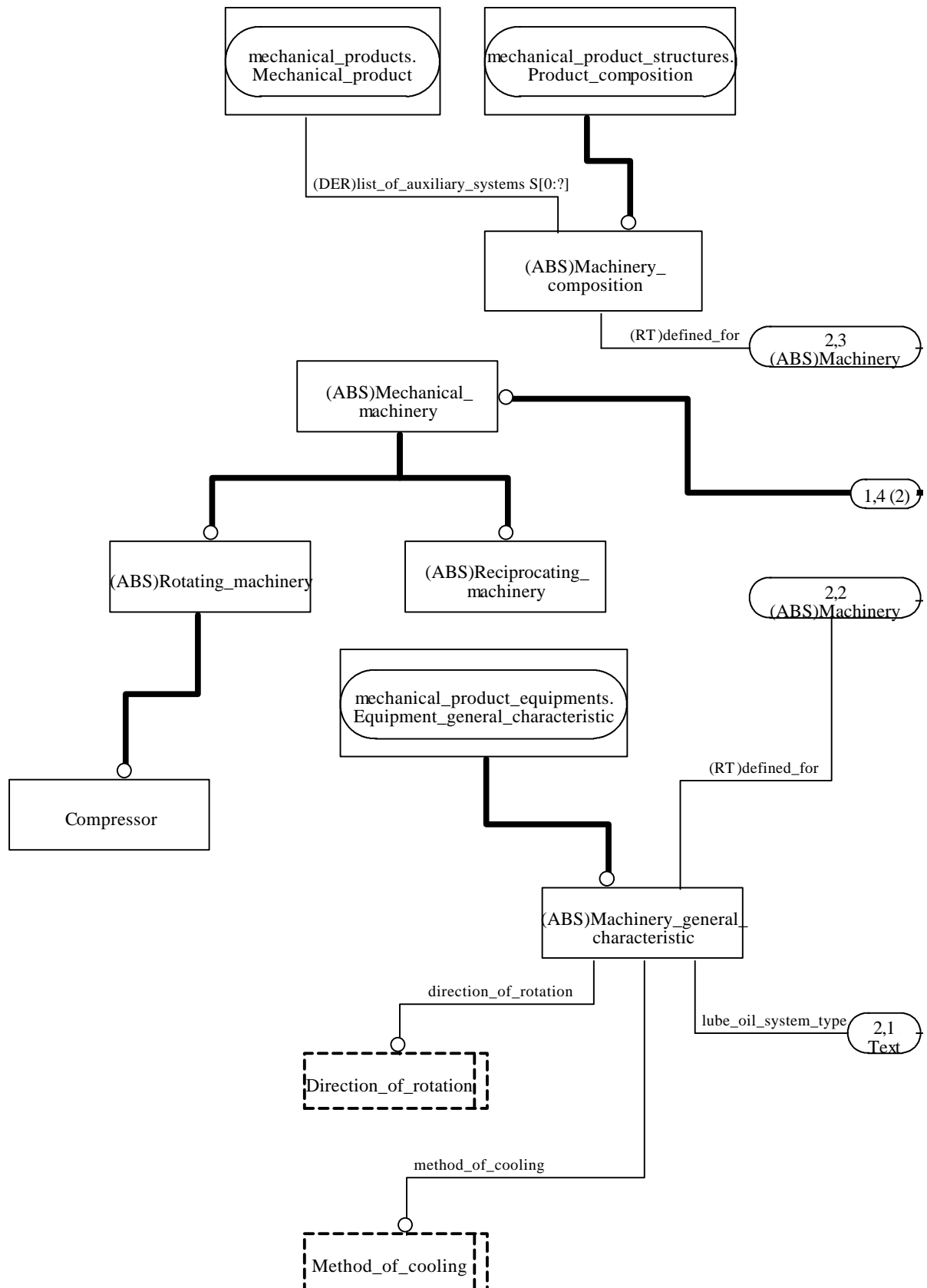


Figure G.30 - Graphical notation of the major aspects of the machineries UoF schema (figure 1 of 3)

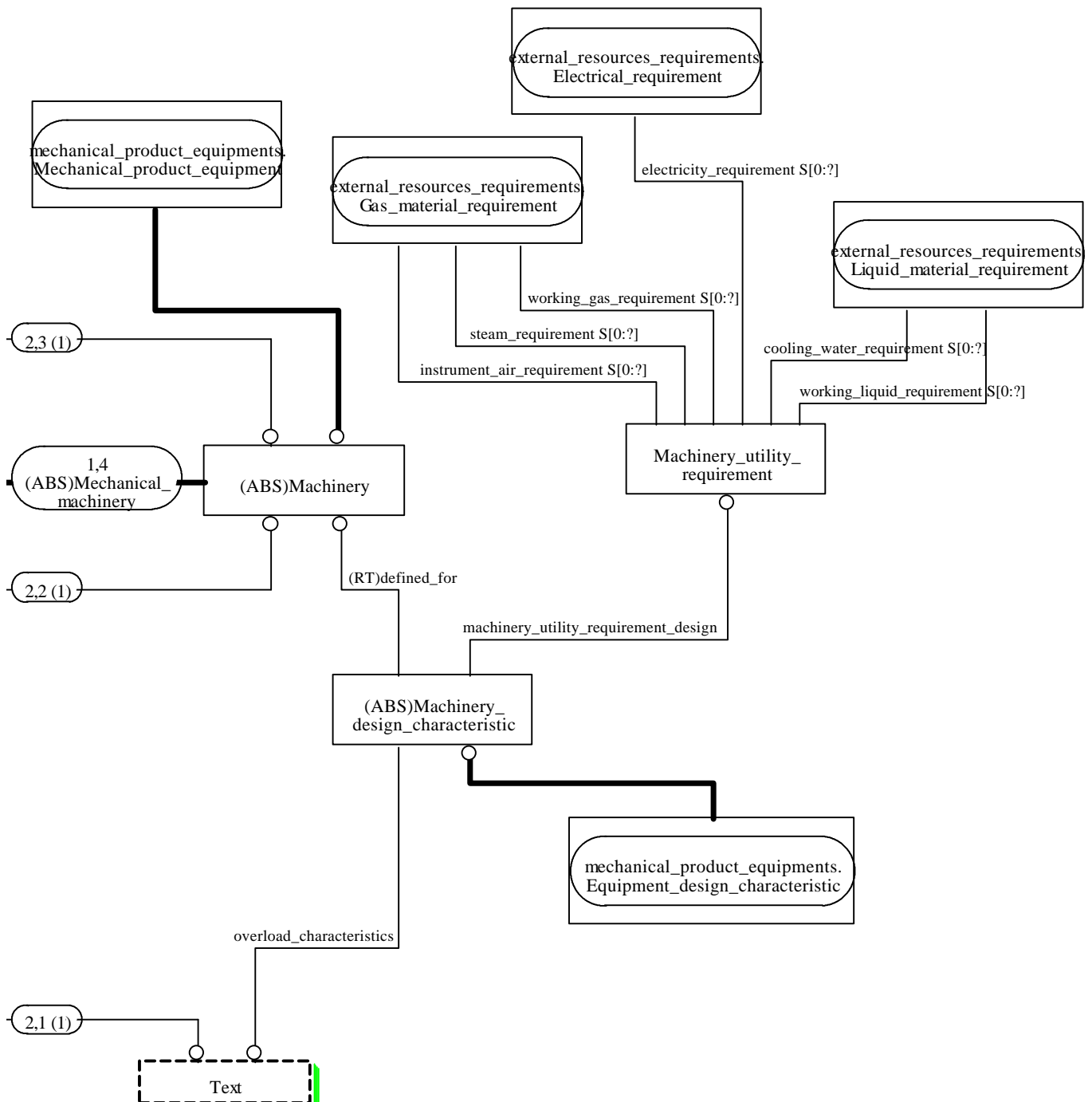


Figure G.31 - Graphical notation of the major aspects of the machineries UoF schema (figure 2 of 3)

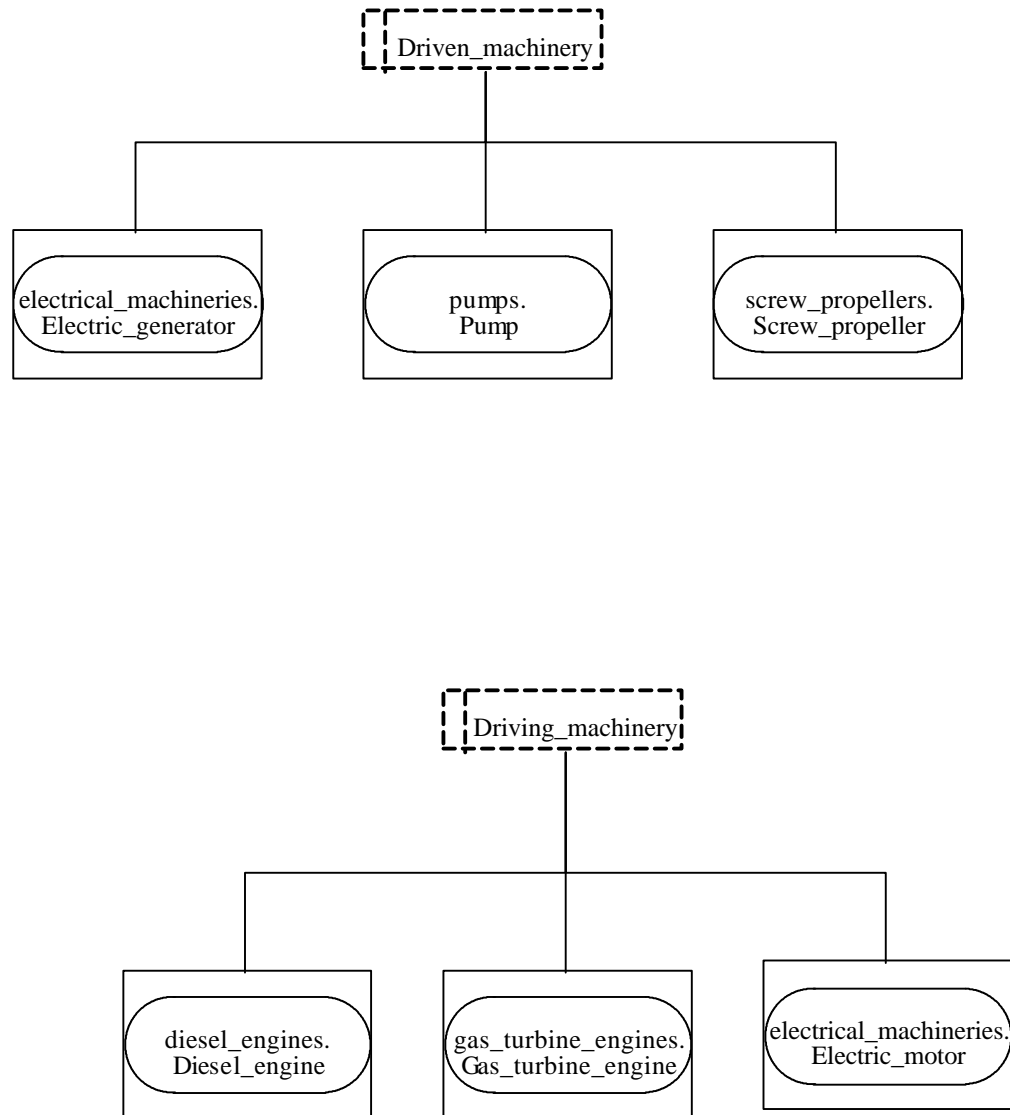


Figure G.32 - Graphical notation of the major aspects of the machineries UoF schema (figure 3 of 3)

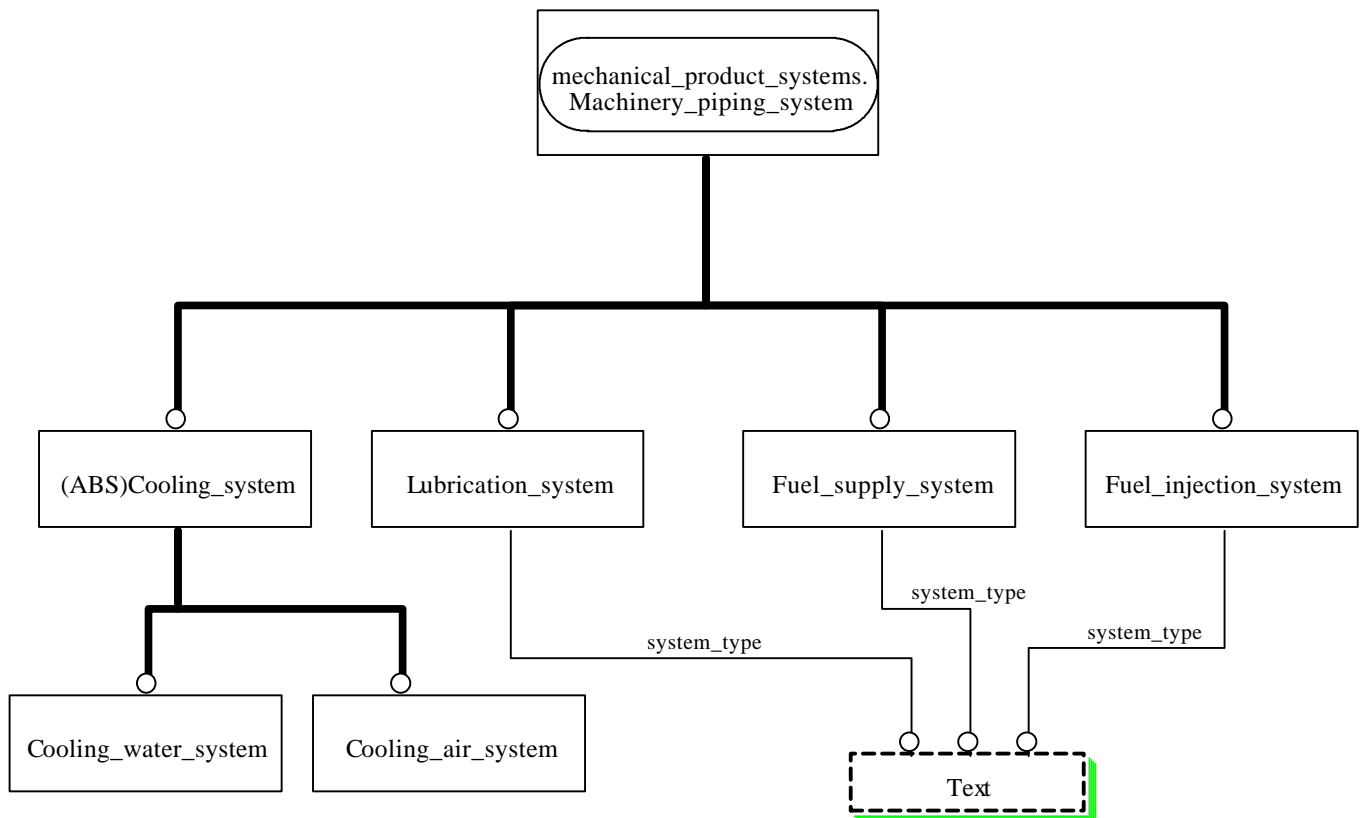


Figure G.33 - Graphical notation of the major aspects of the machinery_piping_systems UoF schema (figure 1 of 1)

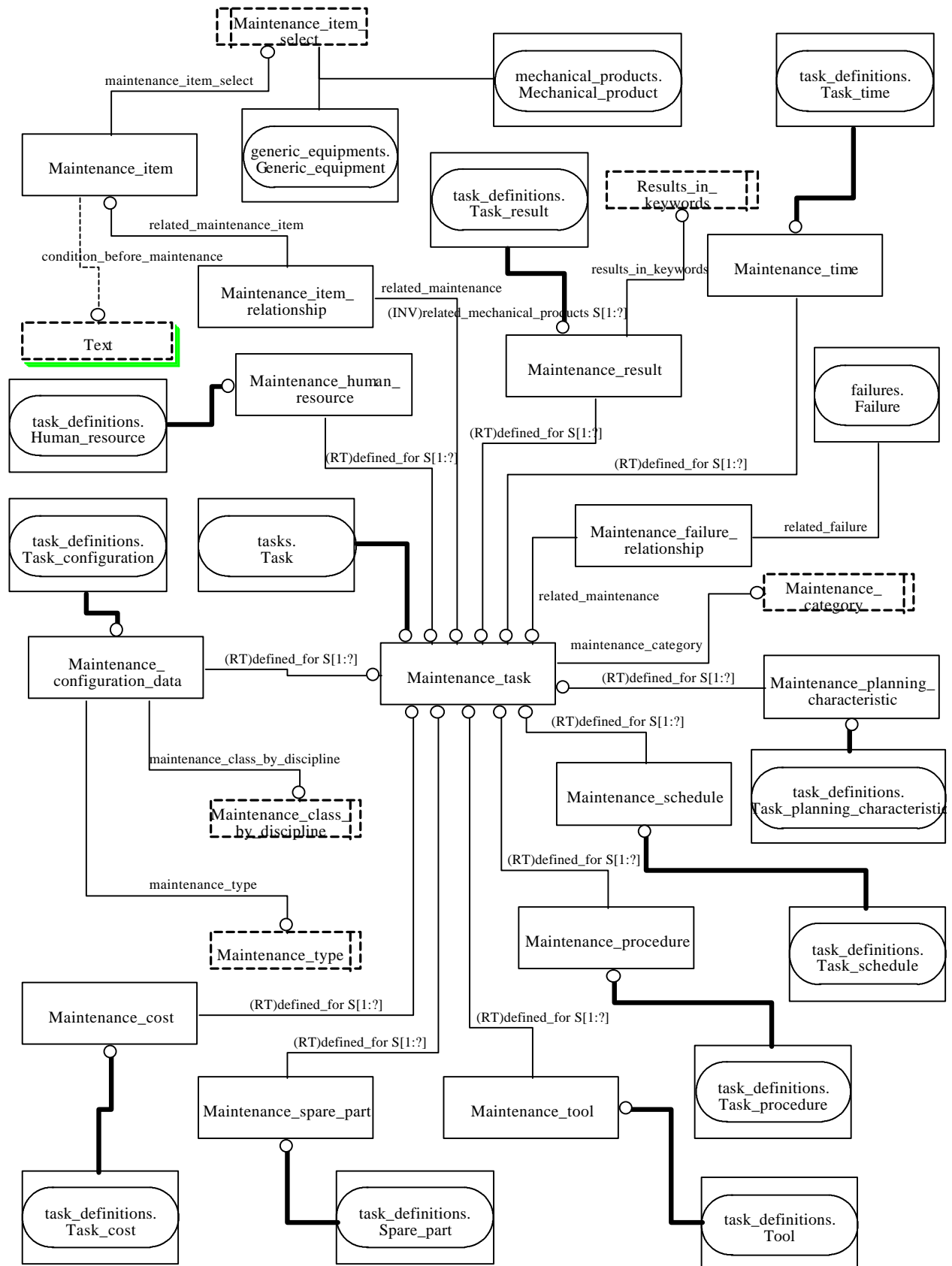


Figure G.34 - Graphical notation of the major aspects of the maintenance_tasks UoF schema (figure 1 of 1)

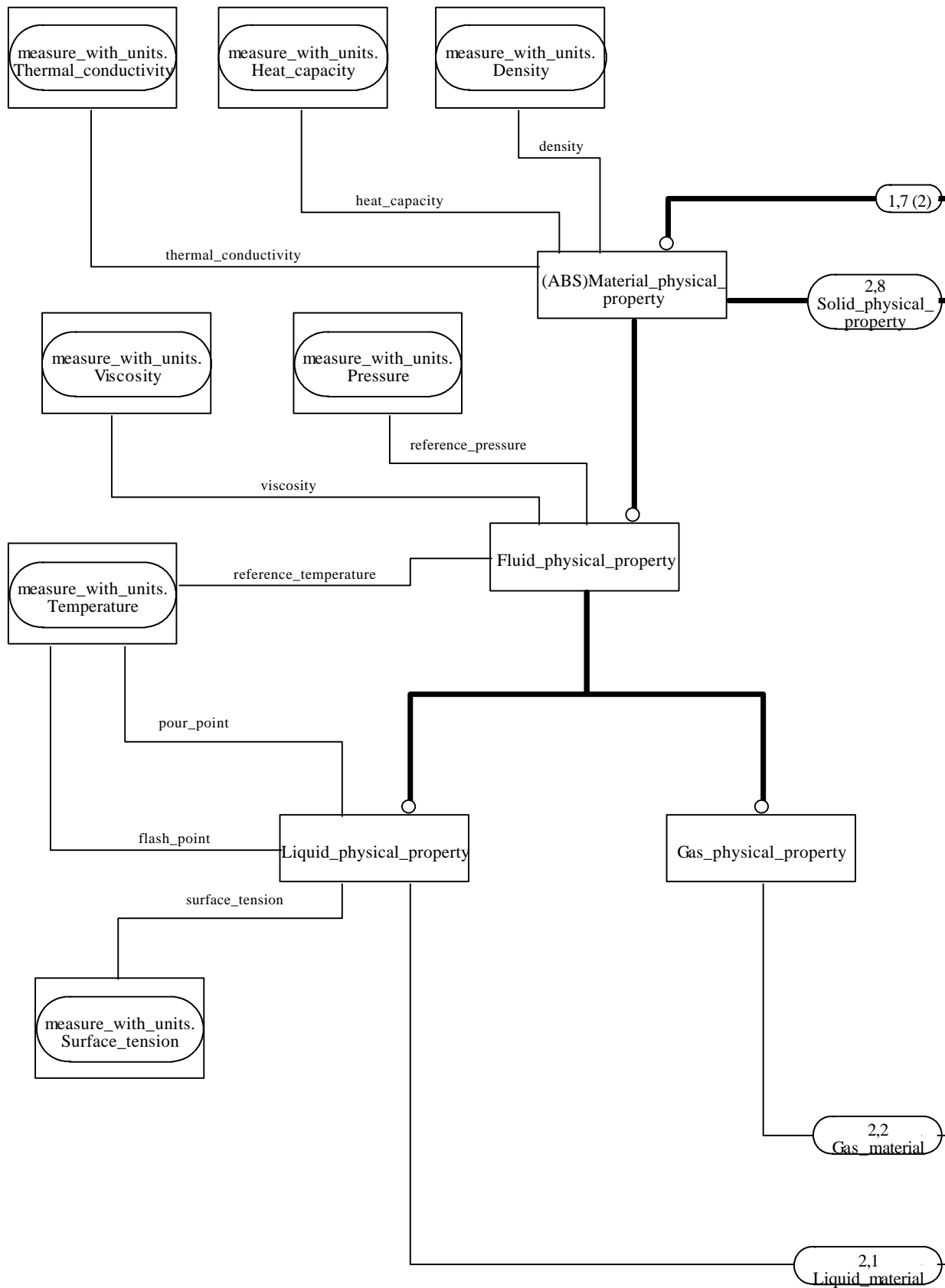


Figure G.35- Graphical notation of the major aspects of the material_properties UoF schema (figure 1 of 3)

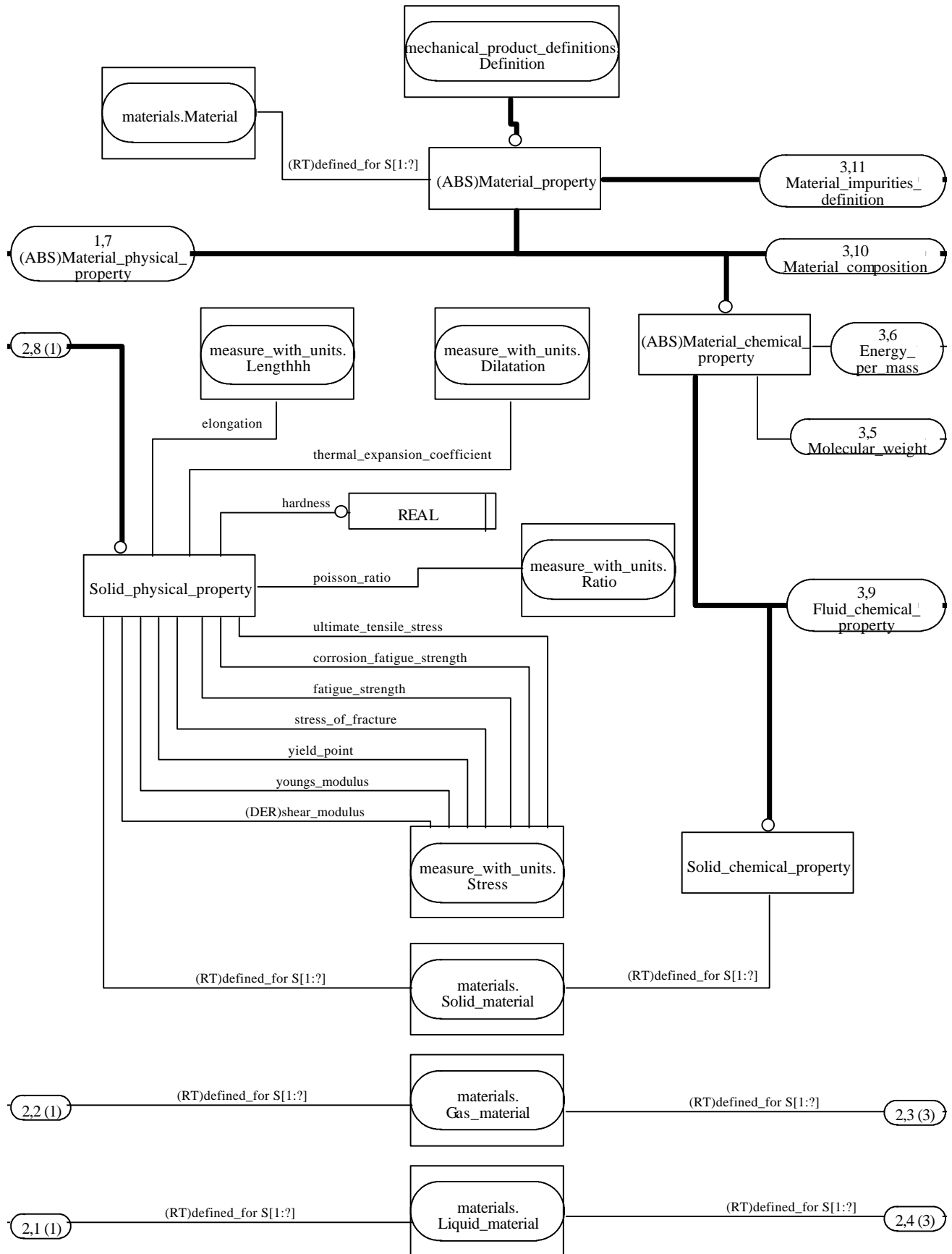


Figure G.36 - Graphical notation of the major aspects of the material_properties UoF schema (figure 2 of 3)

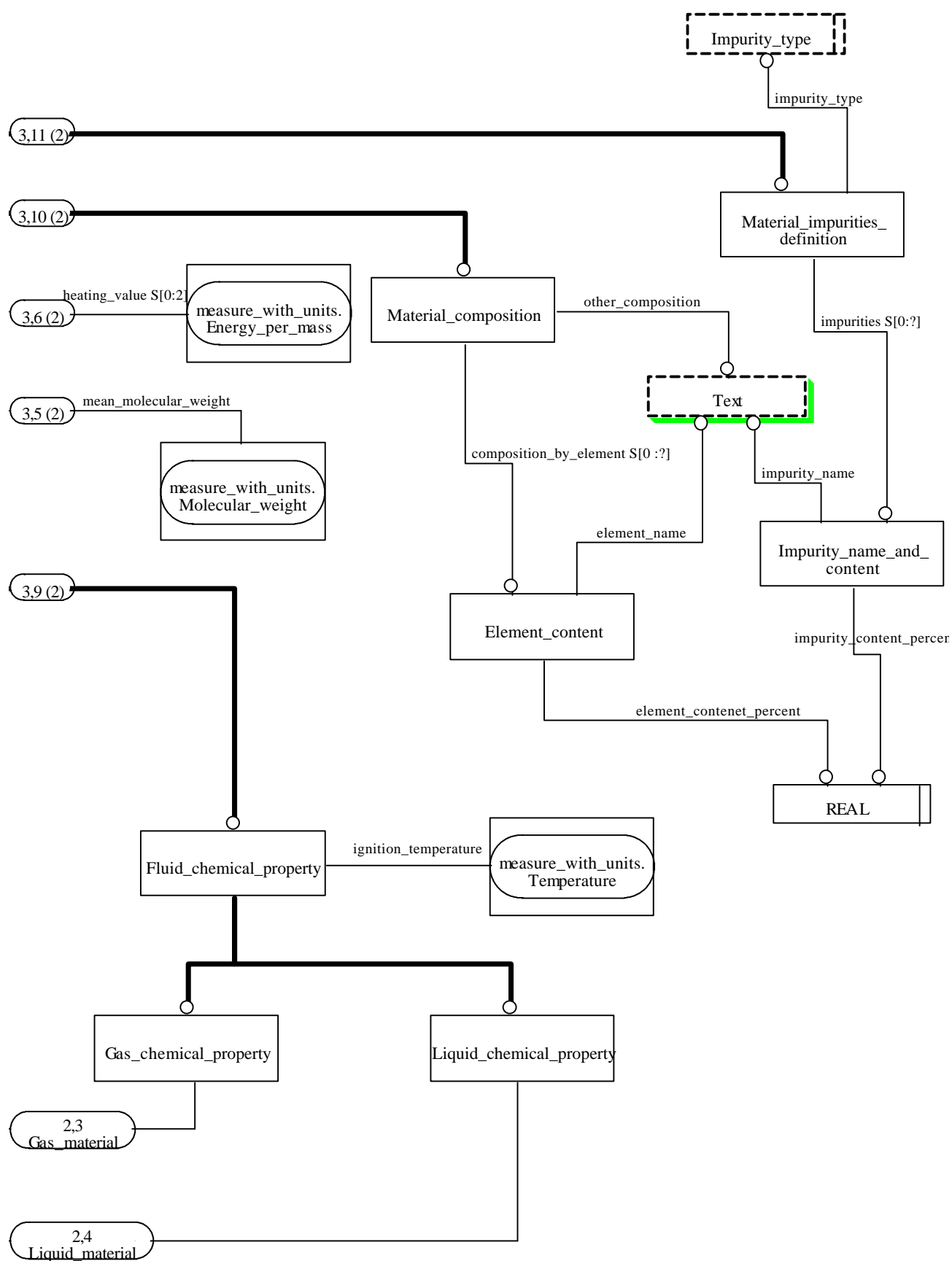


Figure G.37 - Graphical notation of the major aspects of the material_properties UoF schema (figure 3 of 3)

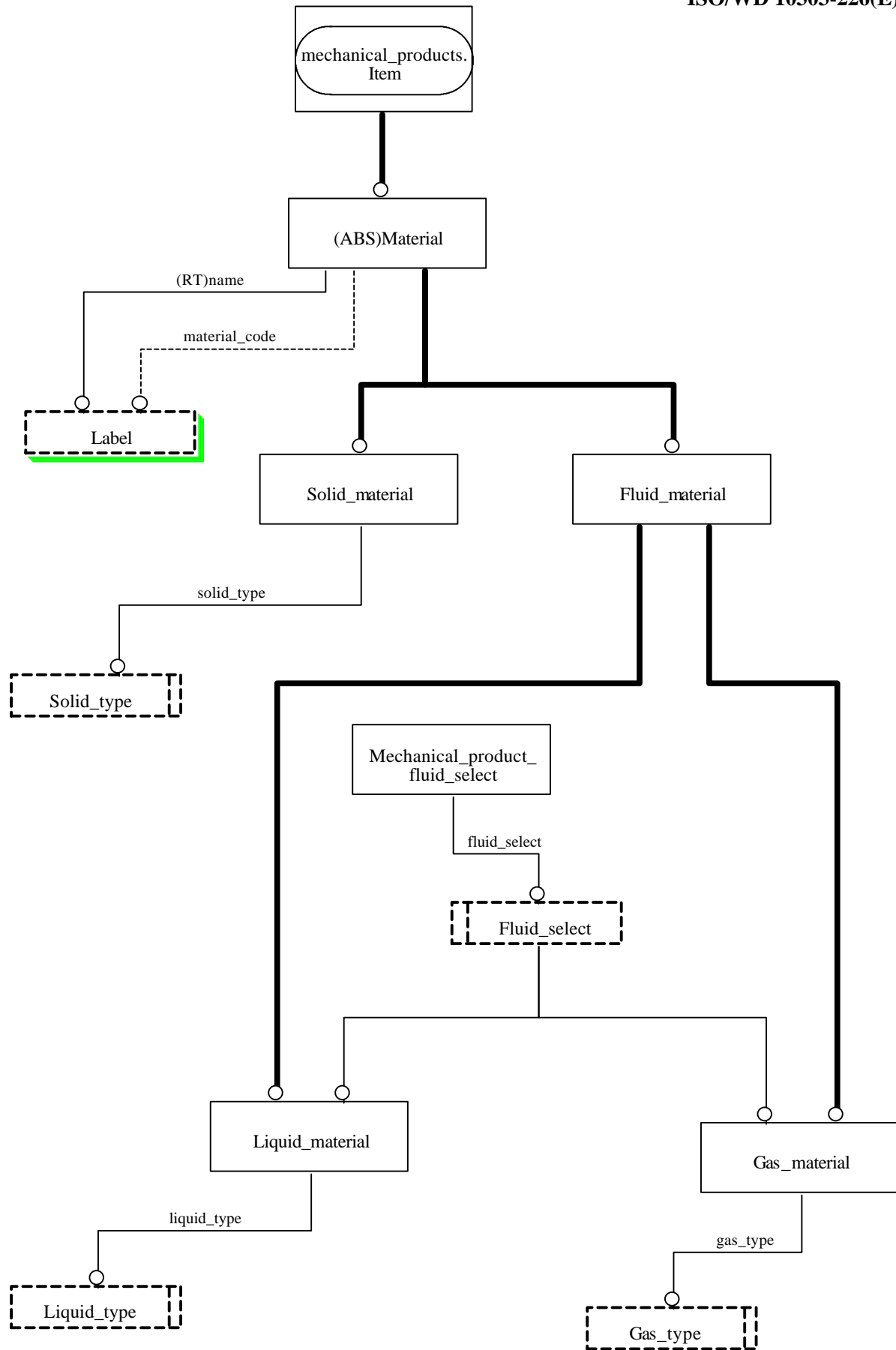


Figure G.38 - Graphical notation of the major aspects of the materials UoF schema (figure 1 of 1)

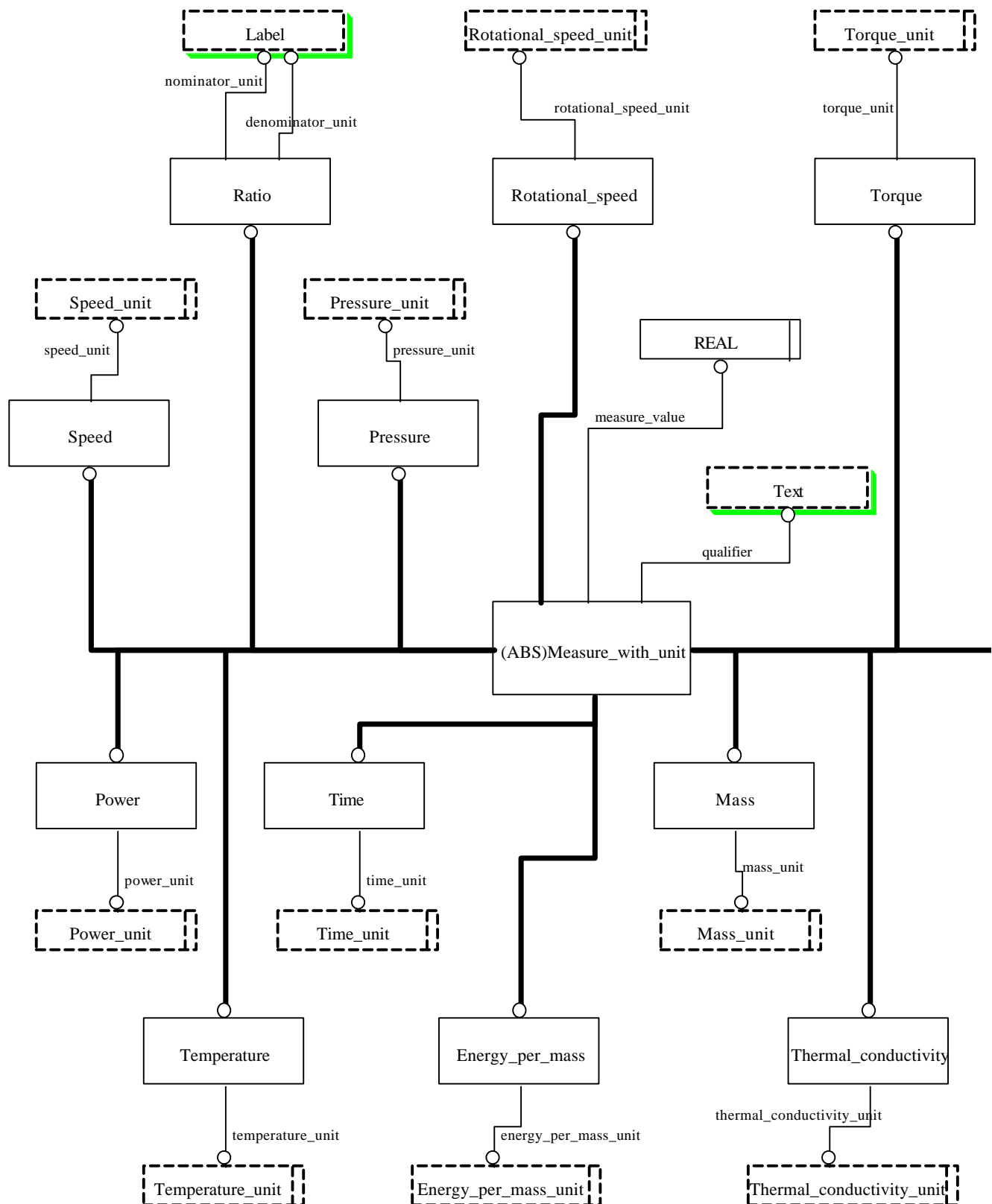


Figure G.39 - Graphical notation of the major aspects of the `measure_with_units` UoF schema (figure 1 of 3)

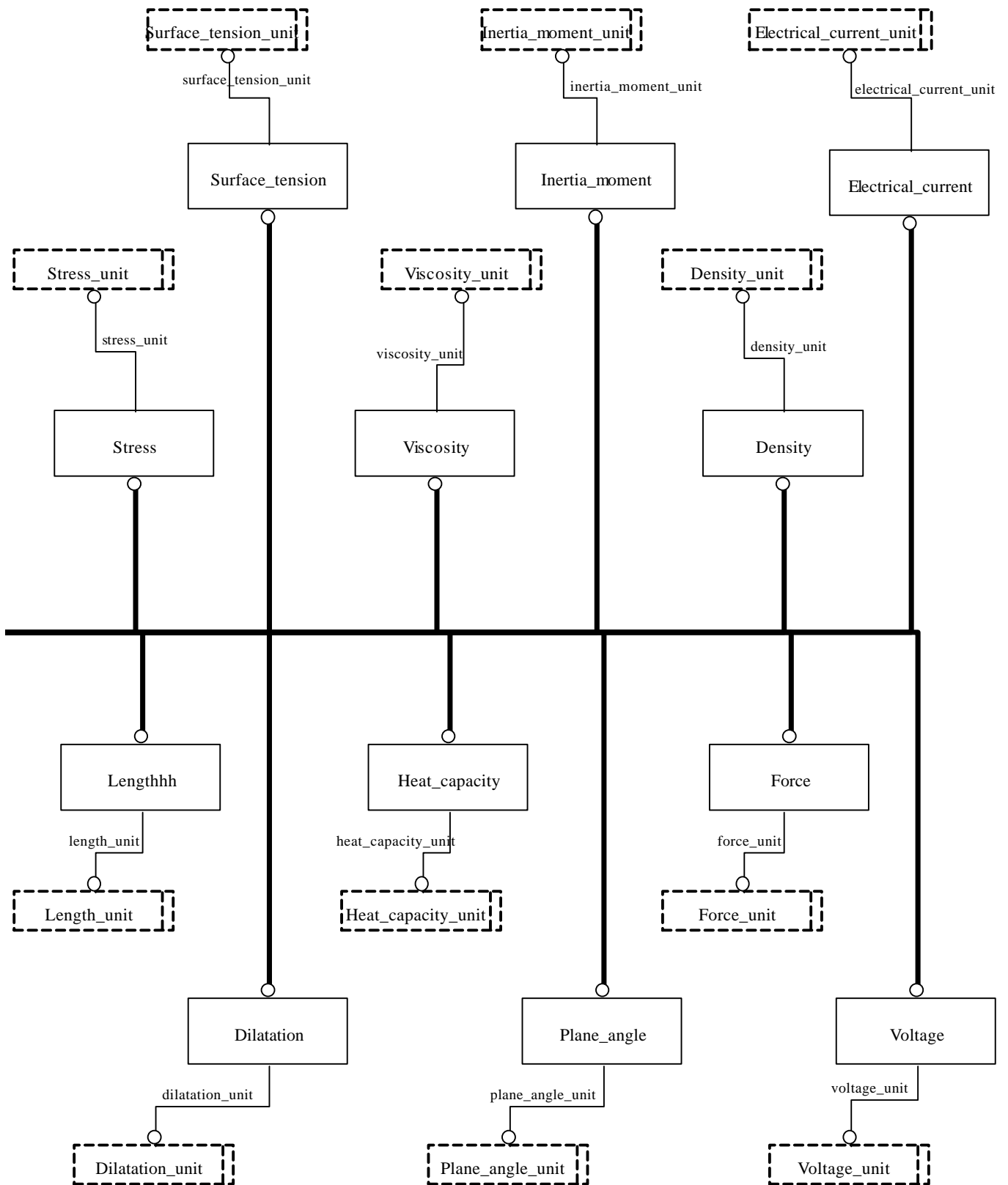


Figure G.40 - Graphical notation of the major aspects of the `measure_with_units` UoF schema (figure 2 of 3)

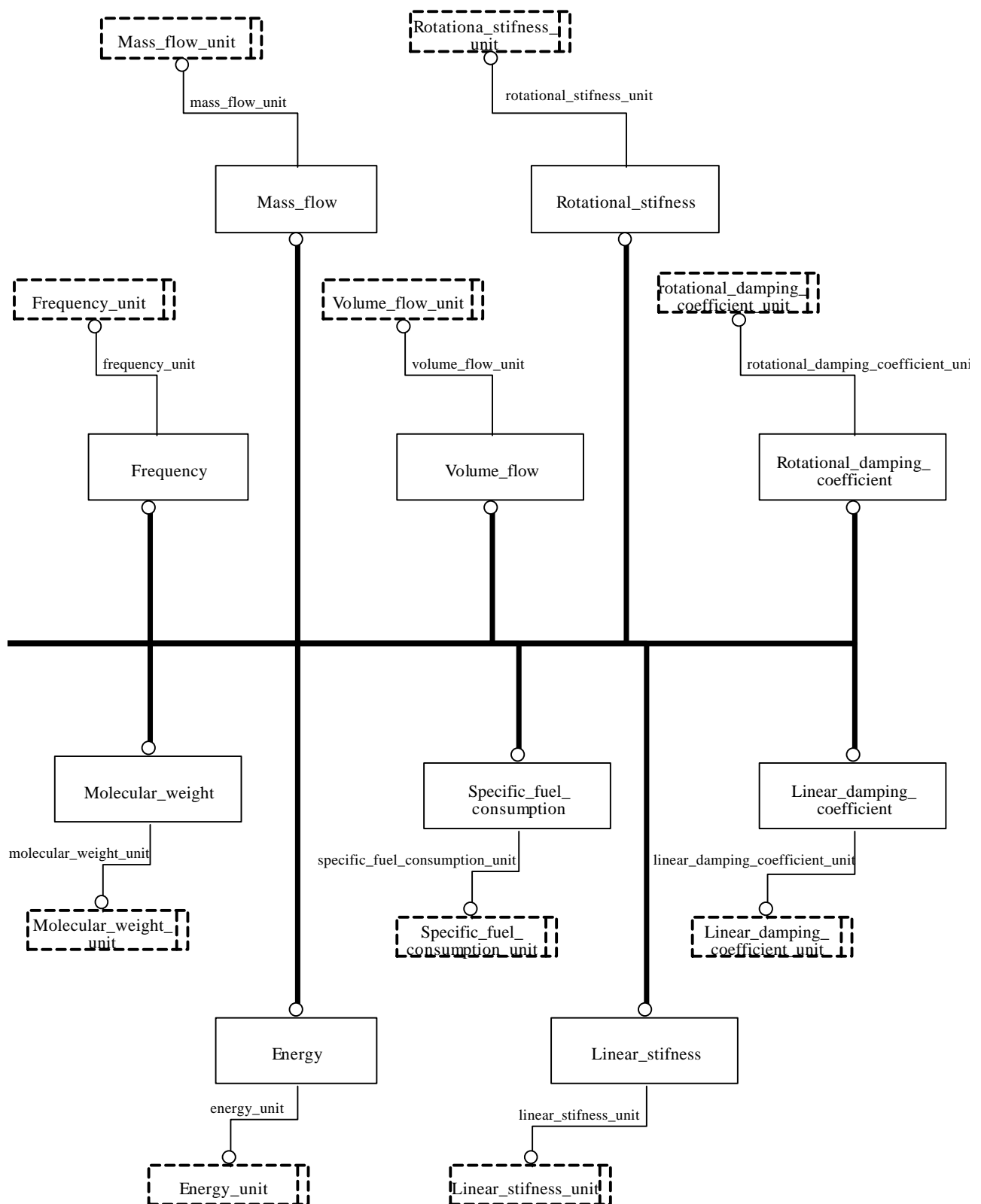


Figure G.41 - Graphical notation of the major aspects of the `measure_with_units` UoF schema (figure 3 of 3)



Figure G.42 - Graphical notation of the major aspects of the mechanical_components UoF schema (figure 1 of 1)

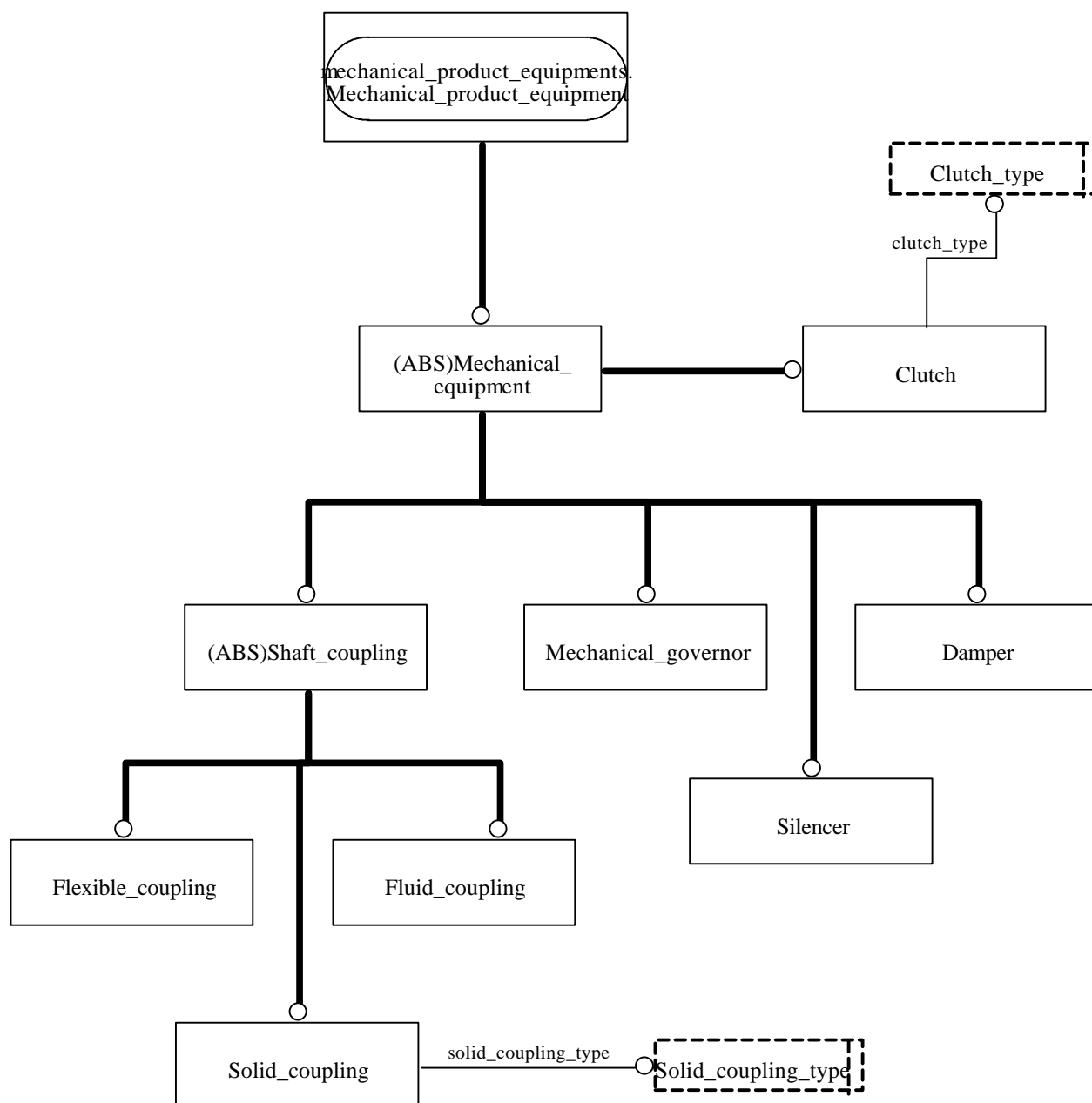


Figure G.43 - Graphical notation of the major aspects of the mechanical equipments UoF schema (figure 1 of 1)

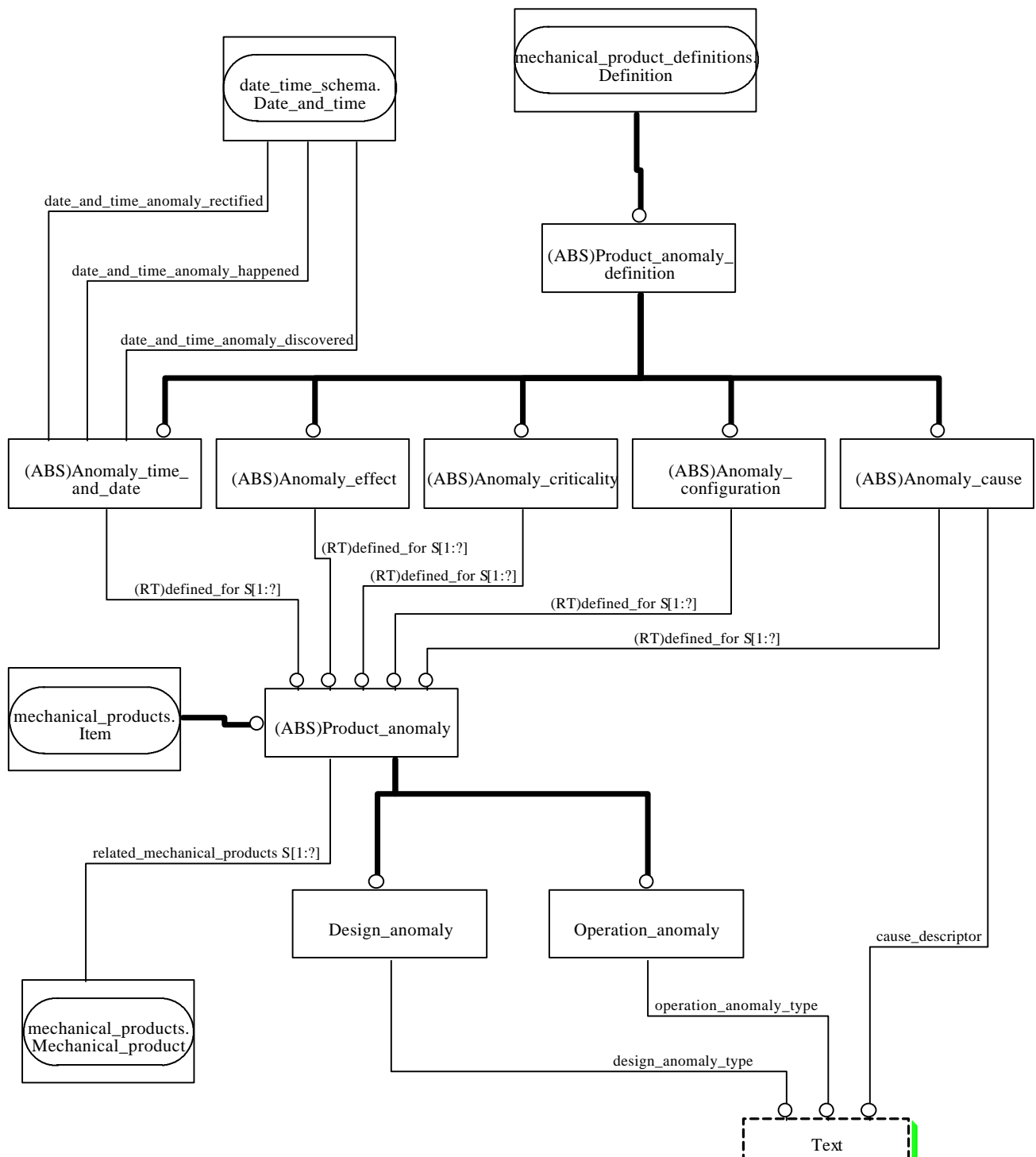


Figure G.44 - Graphical notation of the major aspects of the `mechanical_product_anomalies` UoF schema (figure 1 of 1)

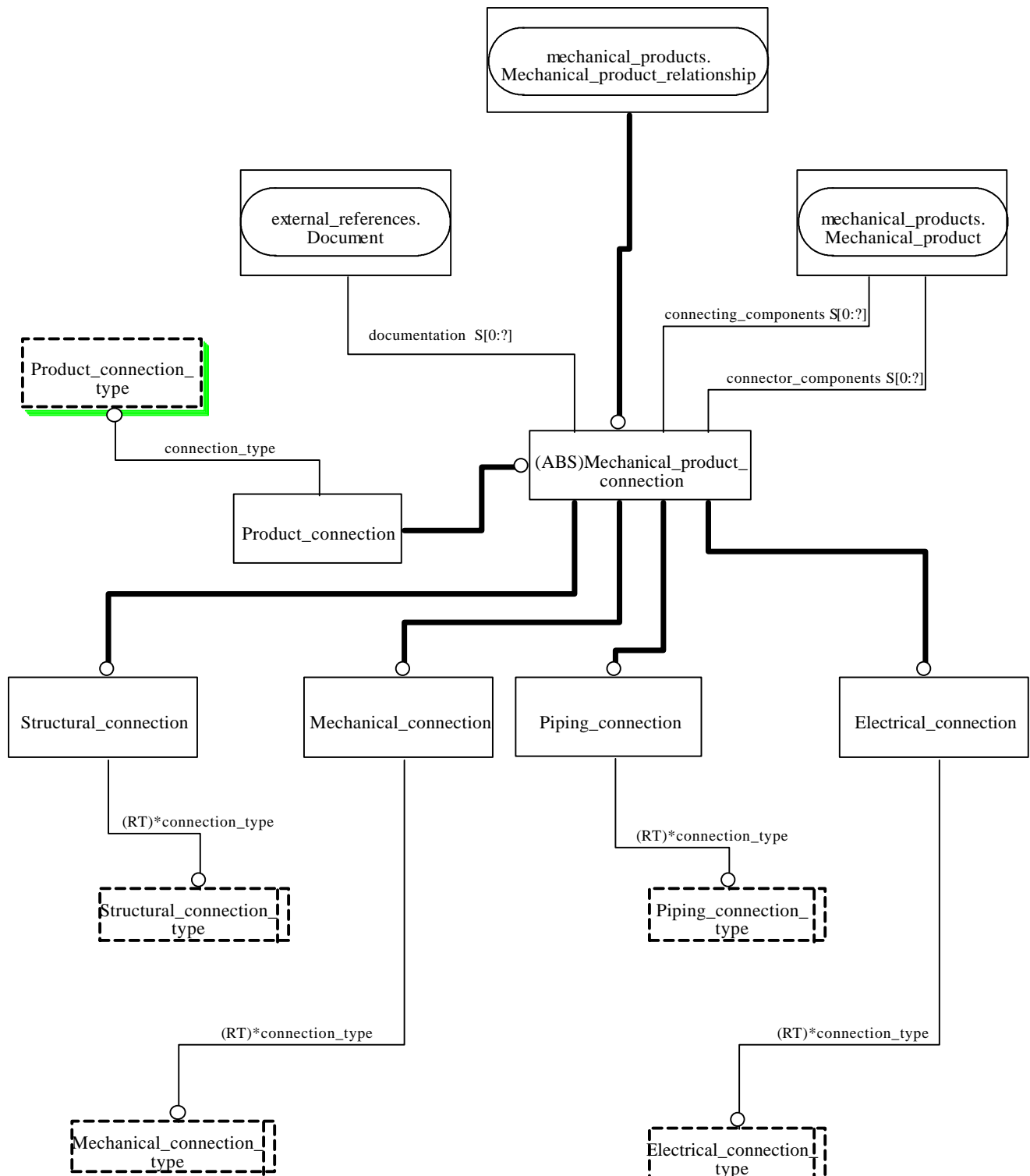


Figure G.45 - Graphical notation of the major aspects of the mechanical_product_connections UoF schema (figure 1 of 1)

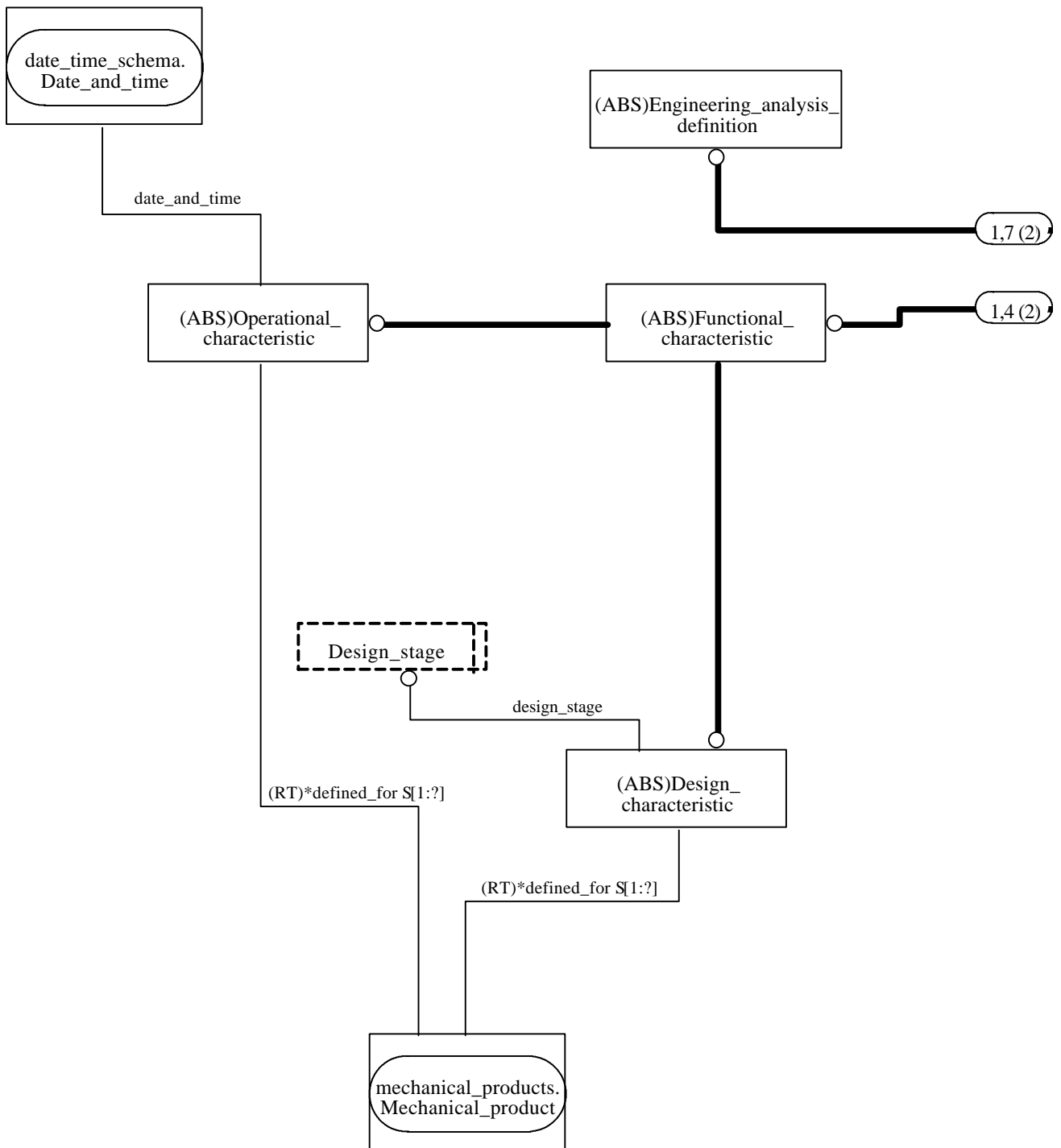


Figure G.46 - Graphical notation of the major aspects of the mechanical_product_definitions UoF schema (figure 1 of 3)

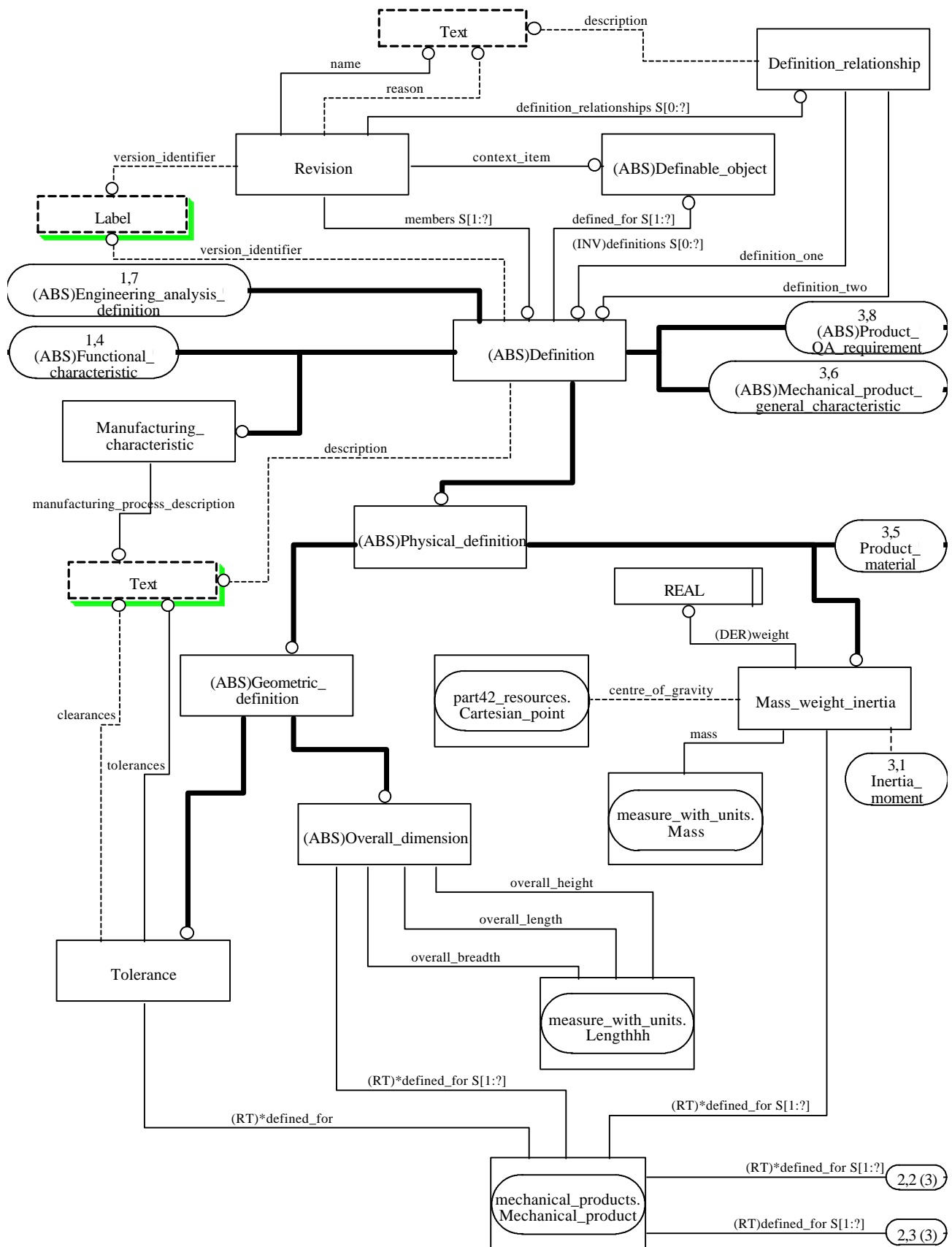


Figure G.47 - Graphical notation of the major aspects of the mechanical_product_definitions UoF schema (figure 2 of 3)

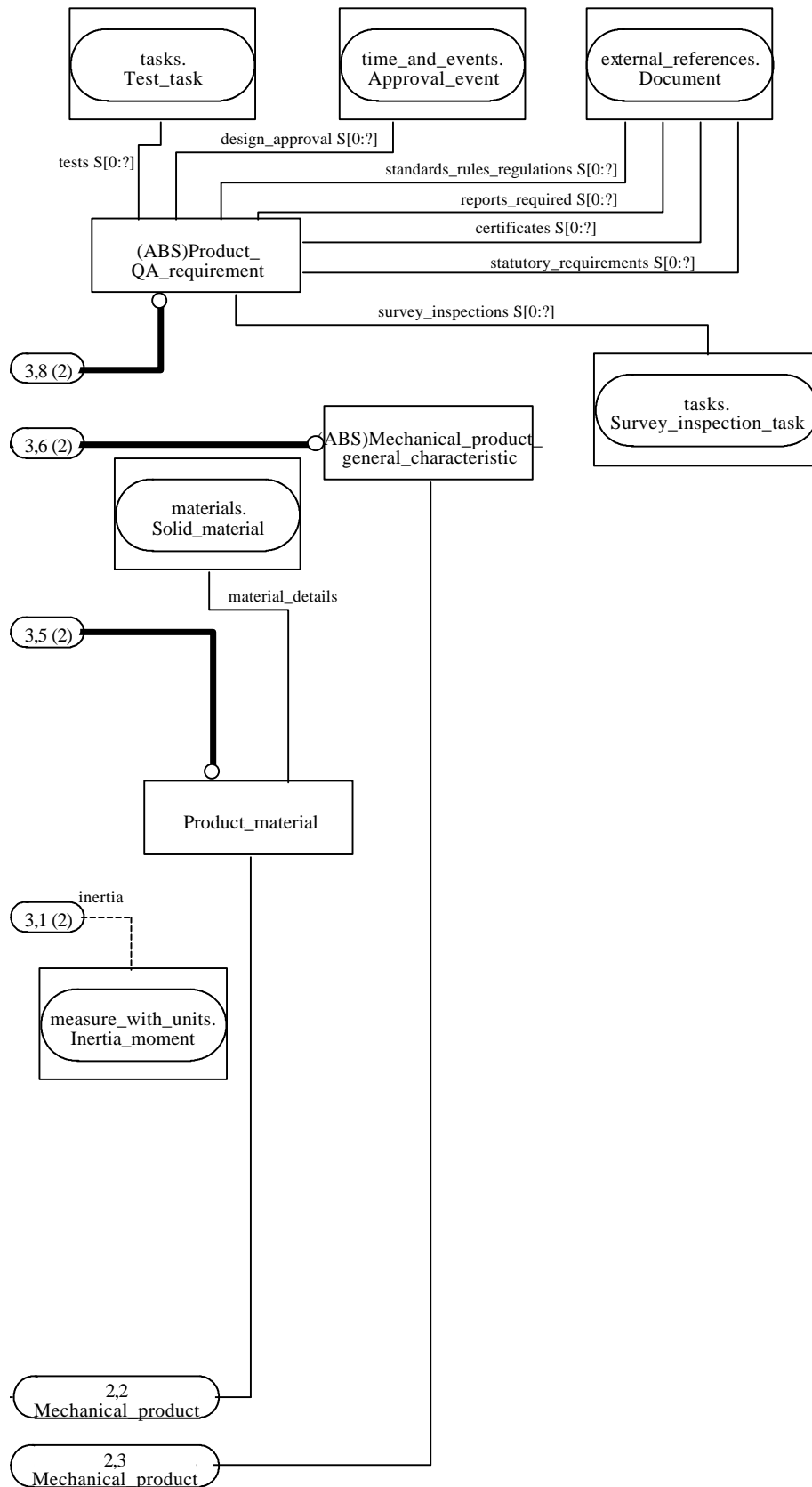


Figure G.48 - Graphical notation of the major aspects of the mechanical_product_definitions UoF schema (figure 3 of 3)

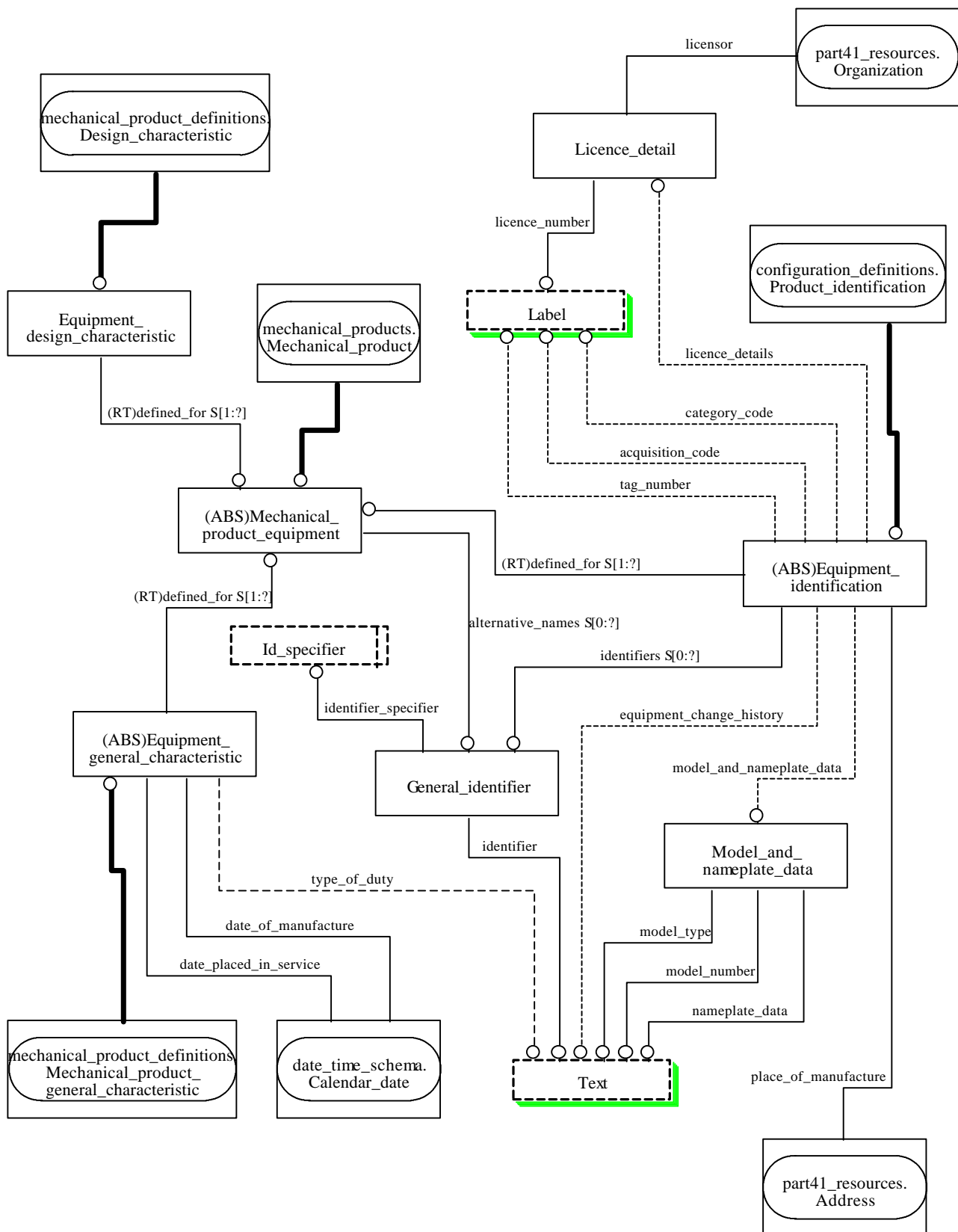


Figure G.49 - Graphical notation of the major aspects of the mechanical_product equipments UoF schema (figure 1 of 1)

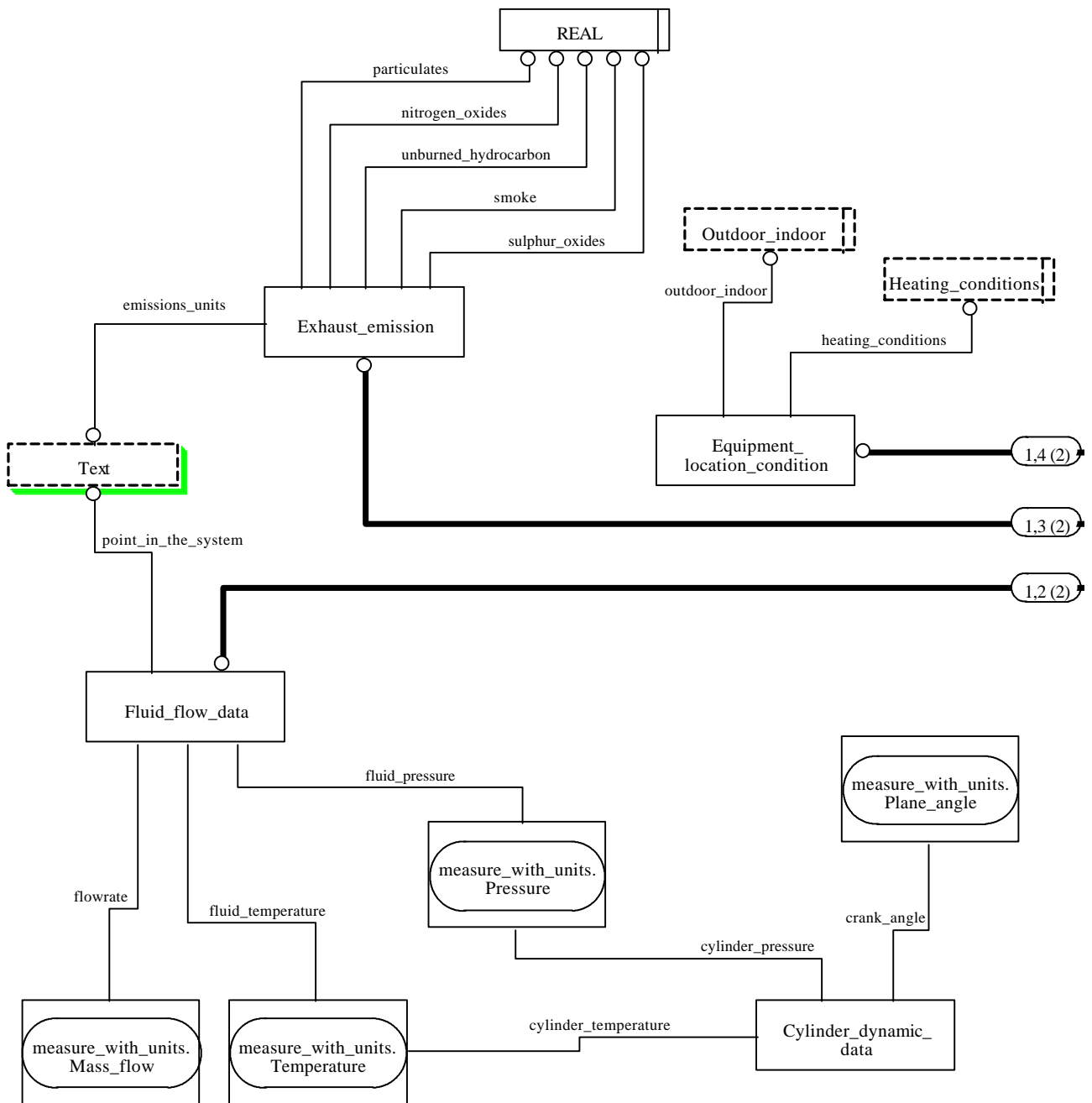


Figure G.50 - Graphical notation of the major aspects of the mechanical_product_properties UoF schema (figure 1 of 3)

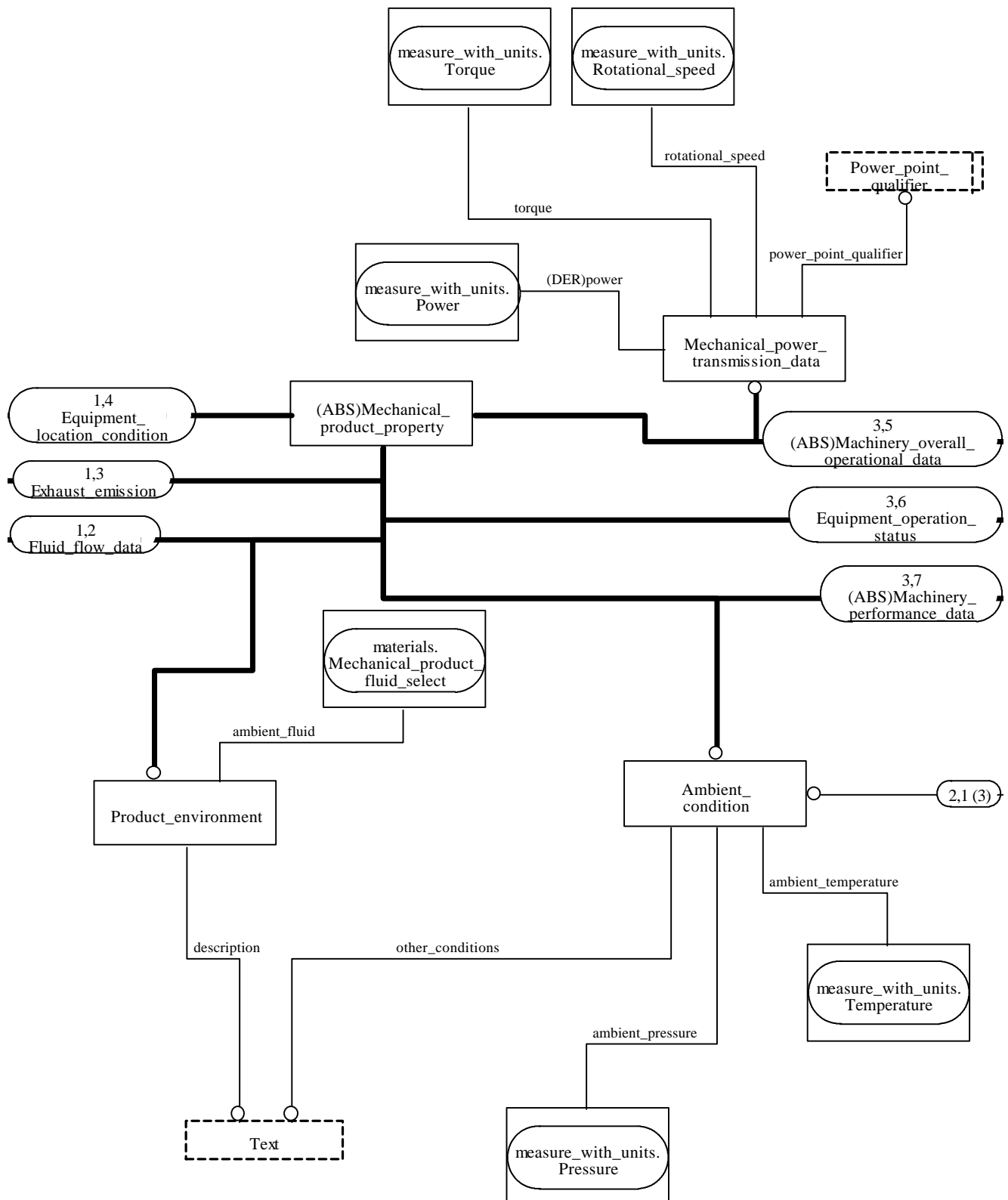


Figure G.51 - Graphical notation of the major aspects of the mechanical_product_properties UoF schema (figure 2 of 3)

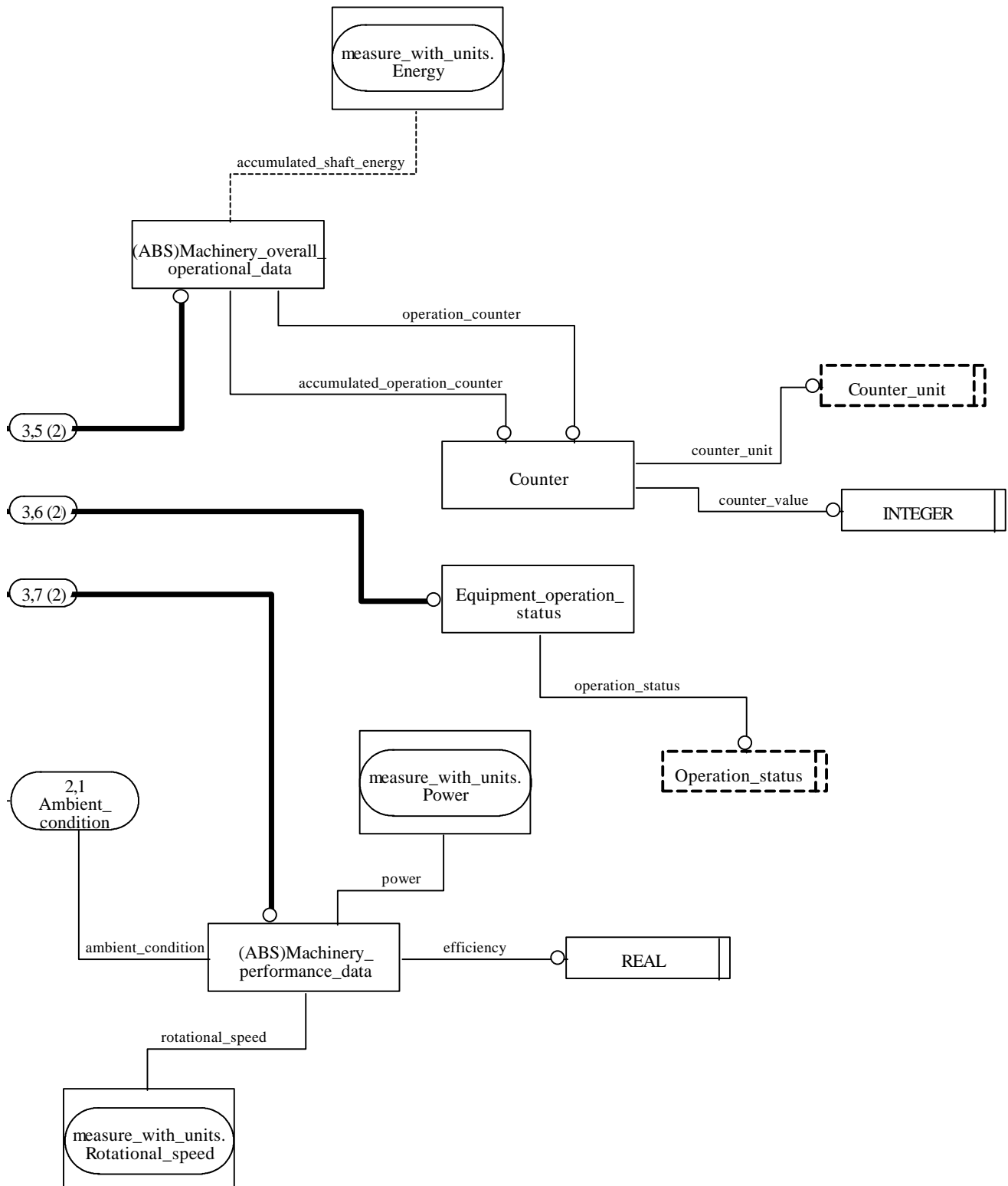


Figure G.52 - Graphical notation of the major aspects of the mechanical_product_properties UoF schema (figure 3 of 3)

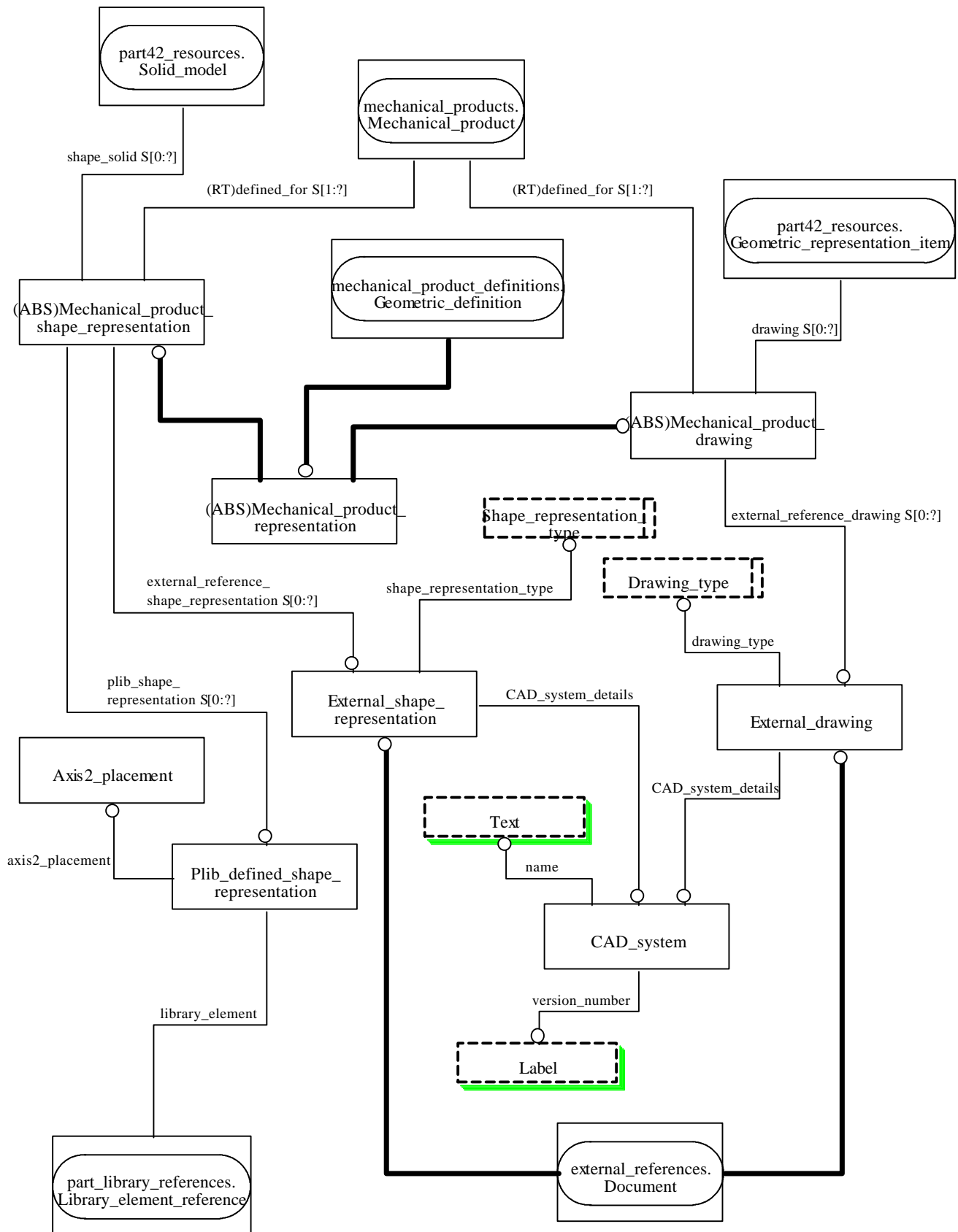


Figure G.53 - Graphical notation of the major aspects of the mechanical_product_representations UoF schema (figure 1 of 1)

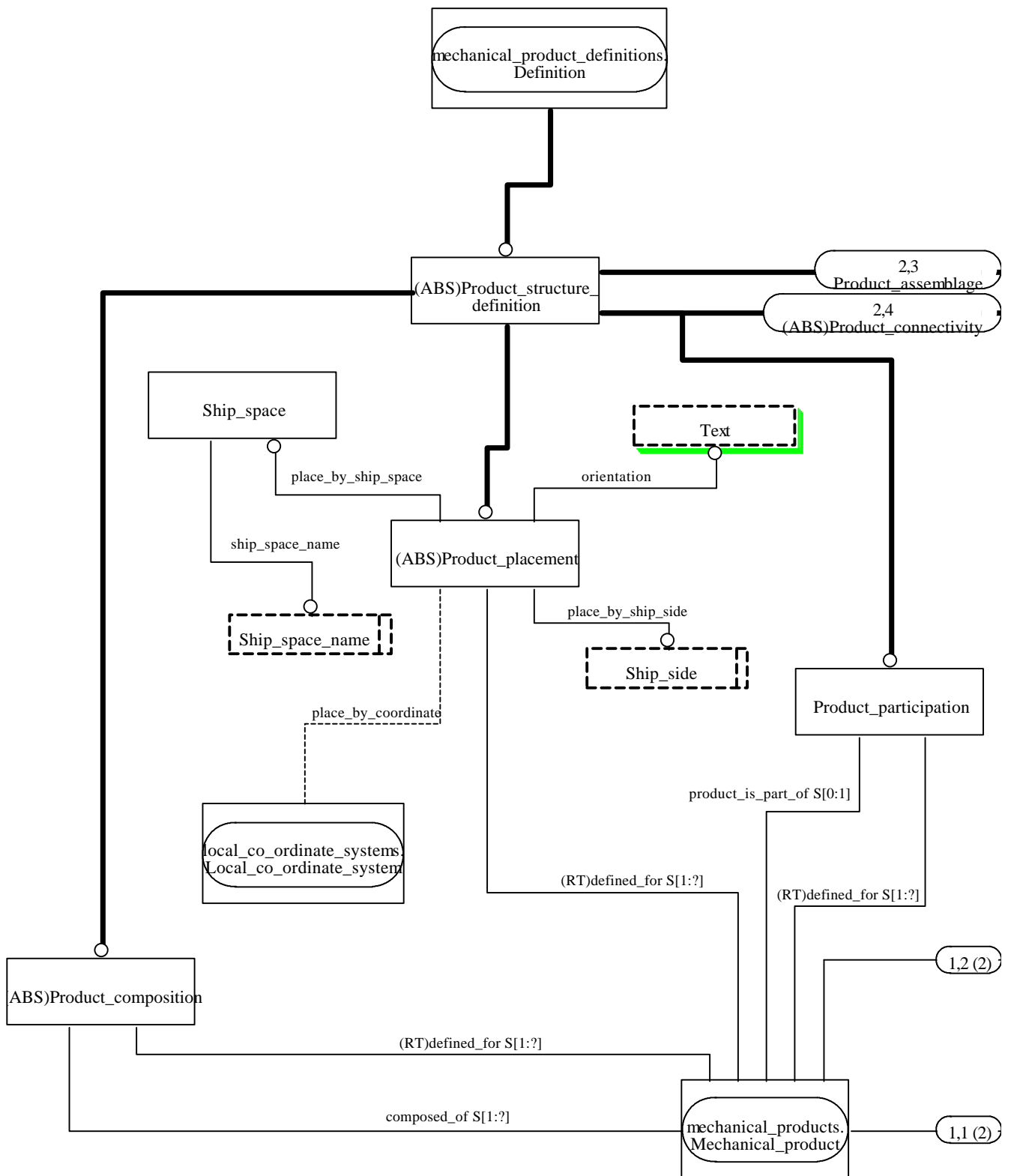


Figure G.54- Graphical notation of the major aspects of the mechanical_product_structures UoF schema (figure 1 of 2)

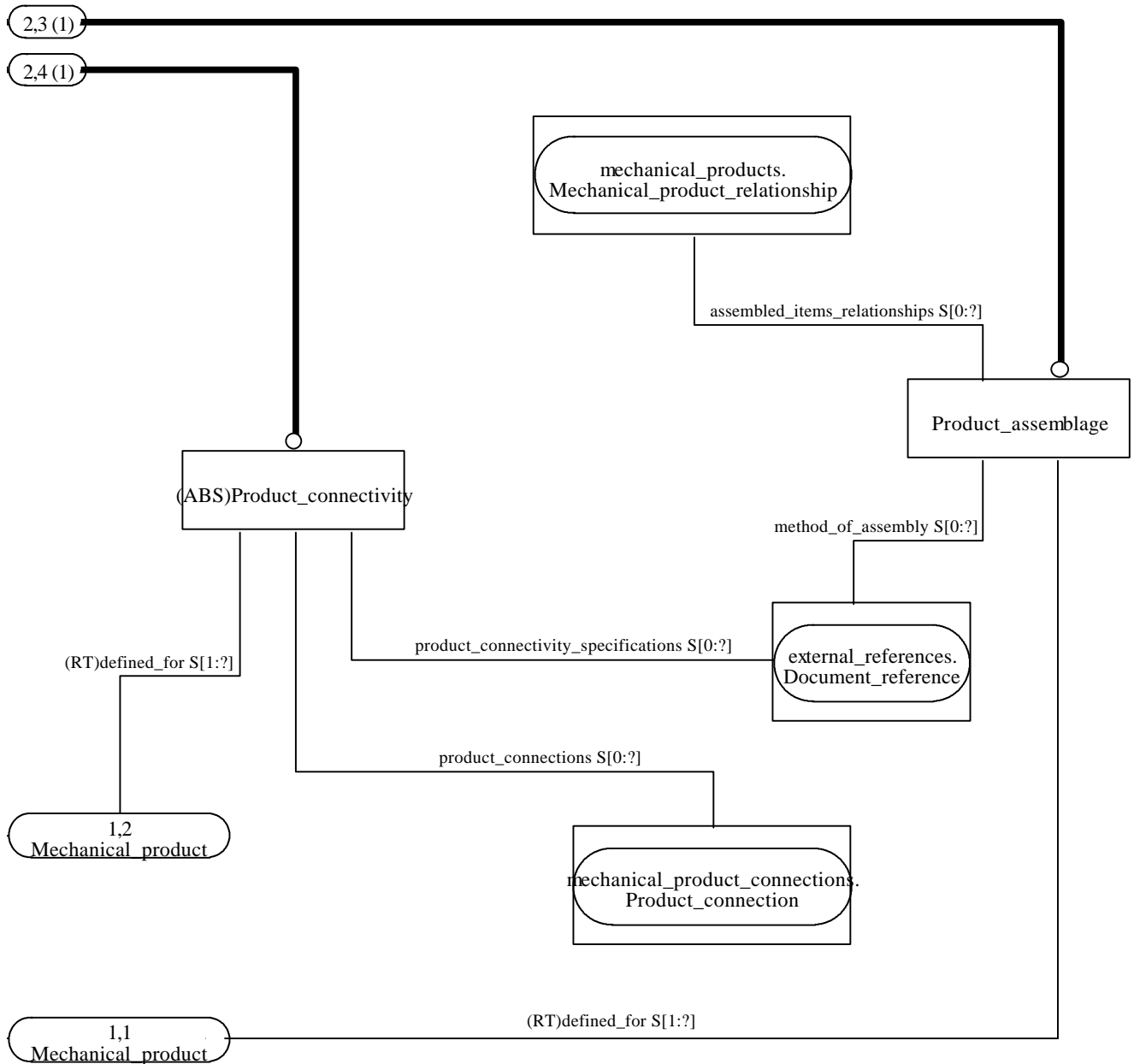


Figure G.55 - Graphical notation of the major aspects of the mechanical_product_structures UoF schema (figure 2 of 2)

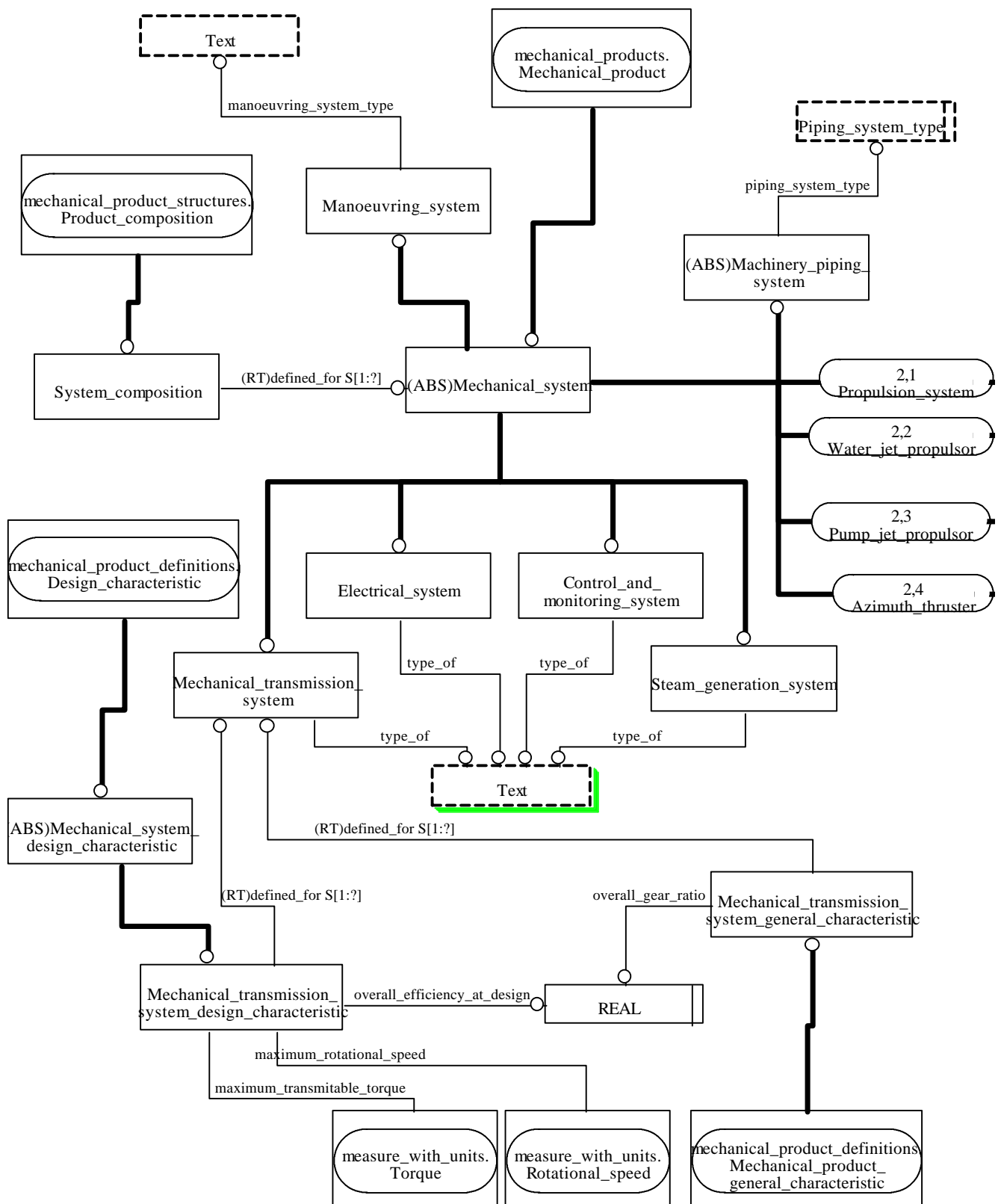


Figure G.56 - Graphical notation of the major aspects of the mechanical_product_systems UoF schema (figure 1 of 2)

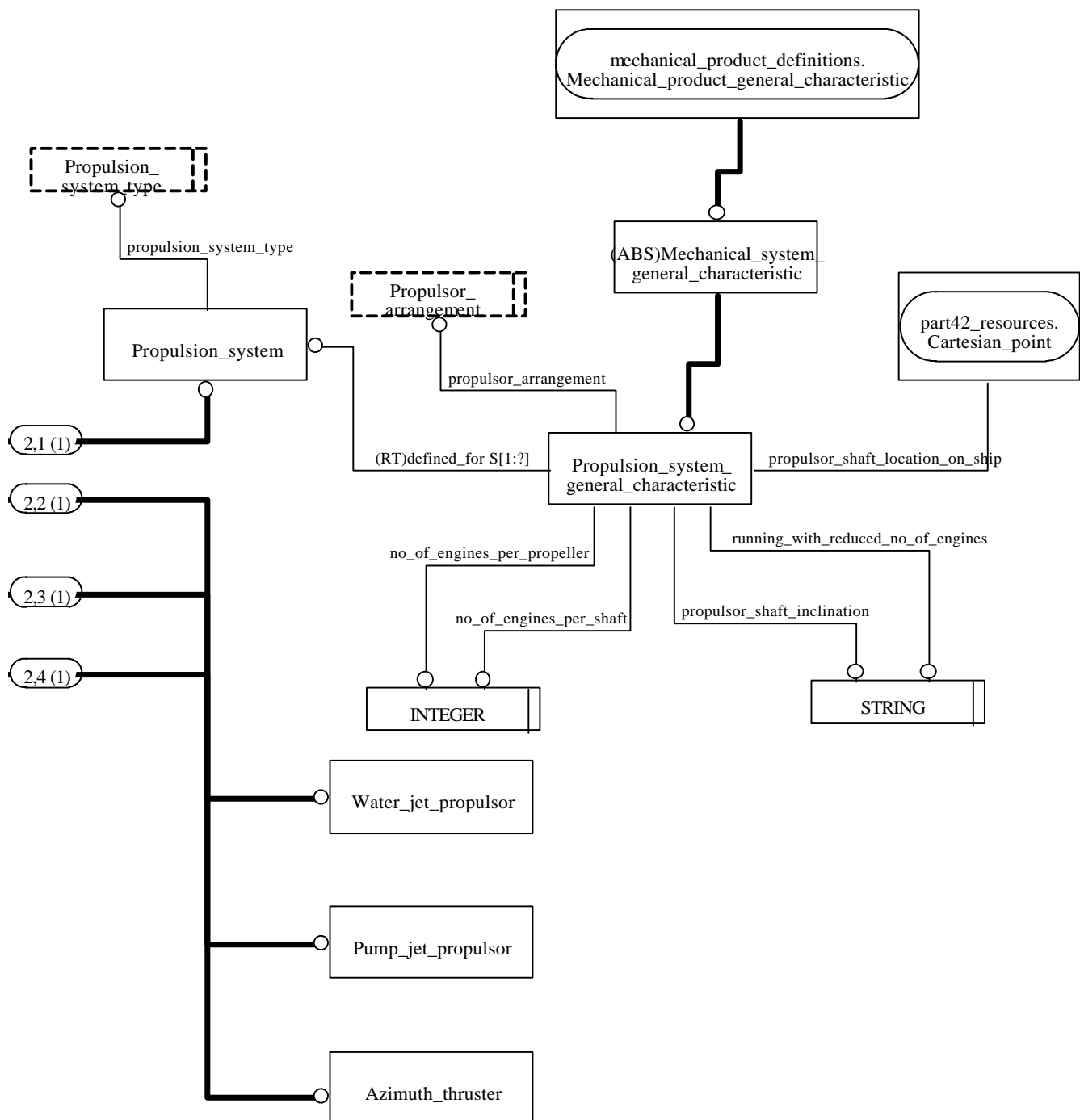


Figure G.57 - Graphical notation of the major aspects of the mechanical_product_systems UoF schema (figure 2 of 2)

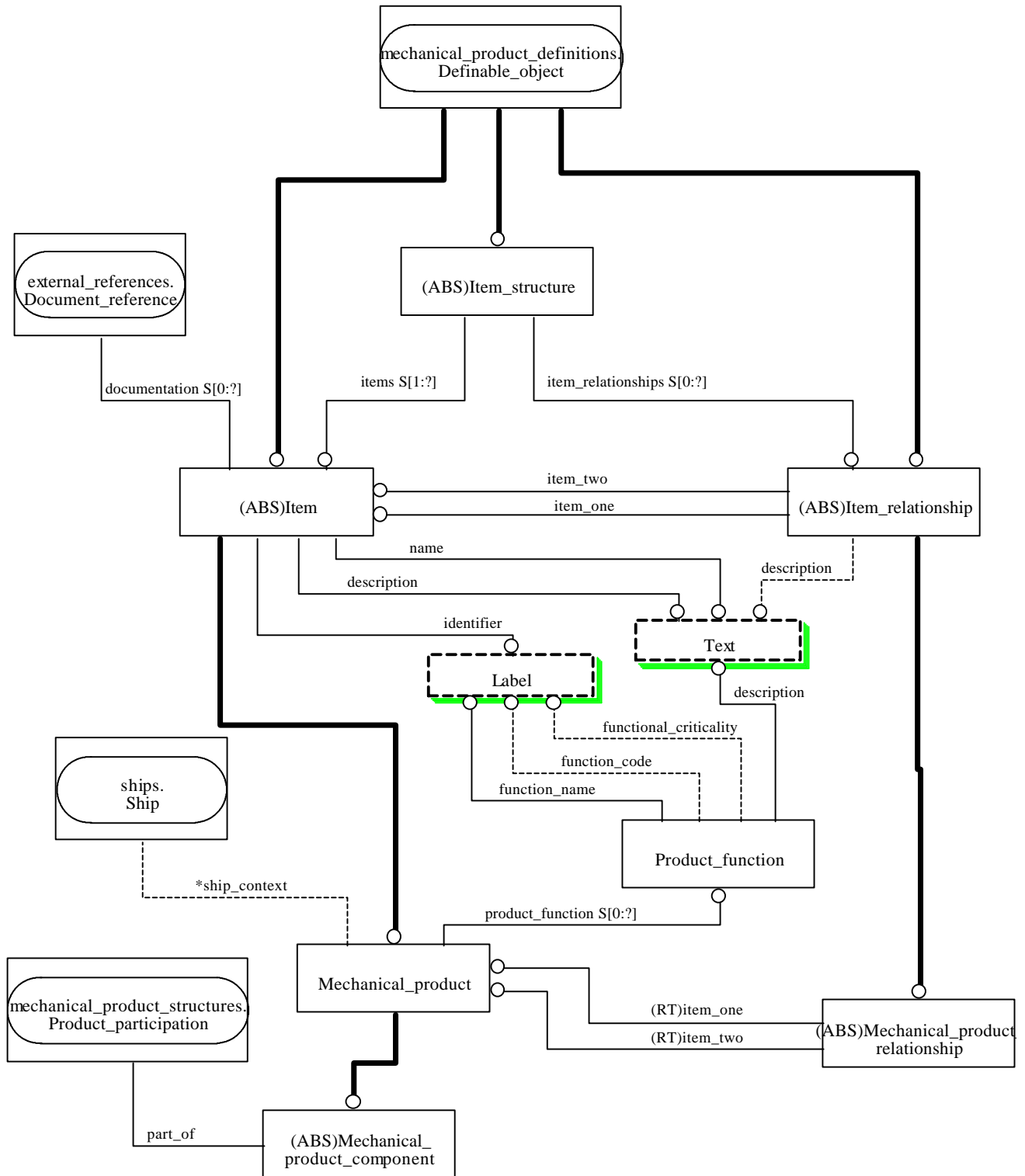


Figure G.58 - Graphical notation of the major aspects of the mechanical_products UoF schema (figure 1 of 1)

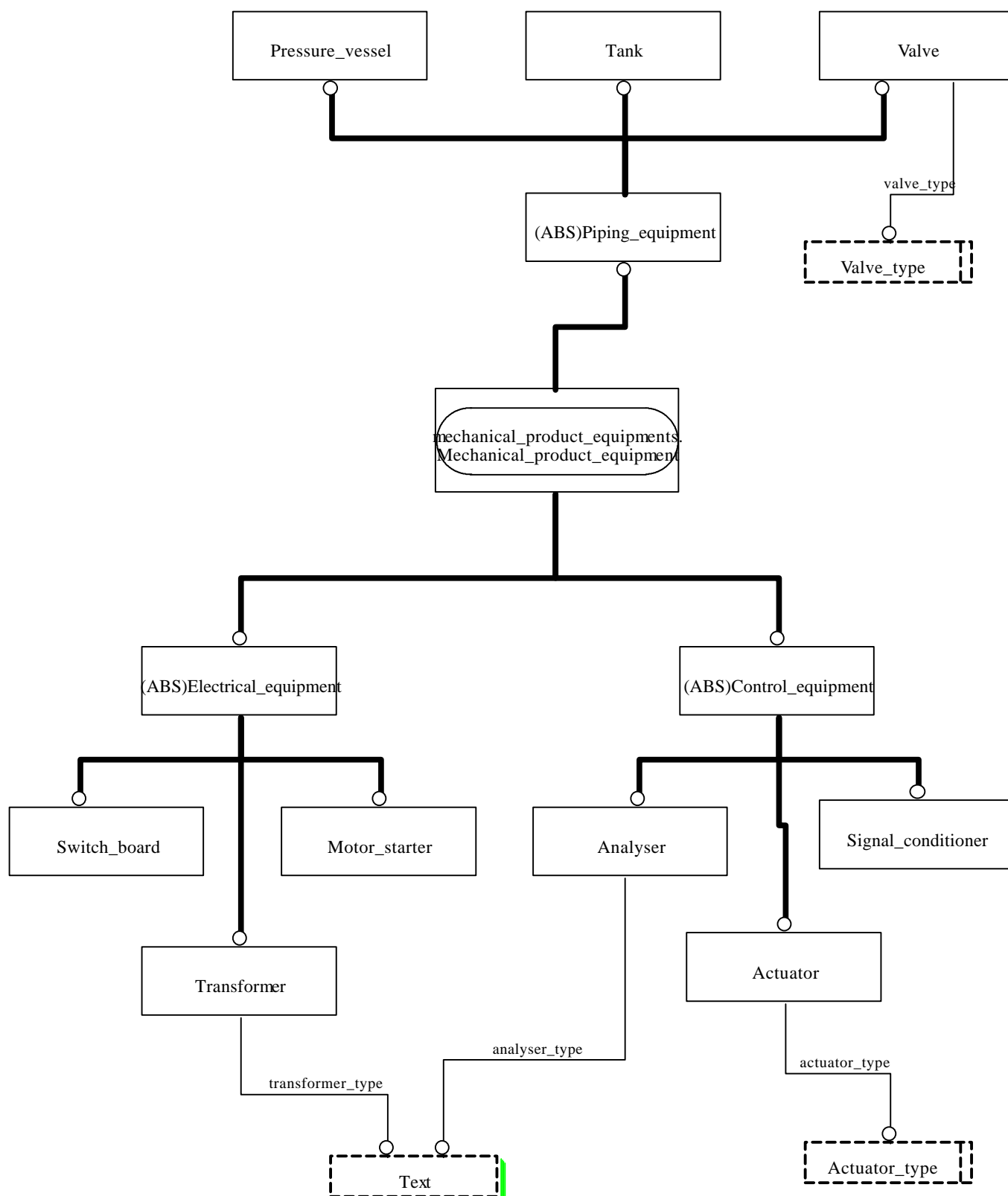


Figure G.59 - Graphical notation of the major aspects of the other equipments UoF schema (figure 1 of 1)

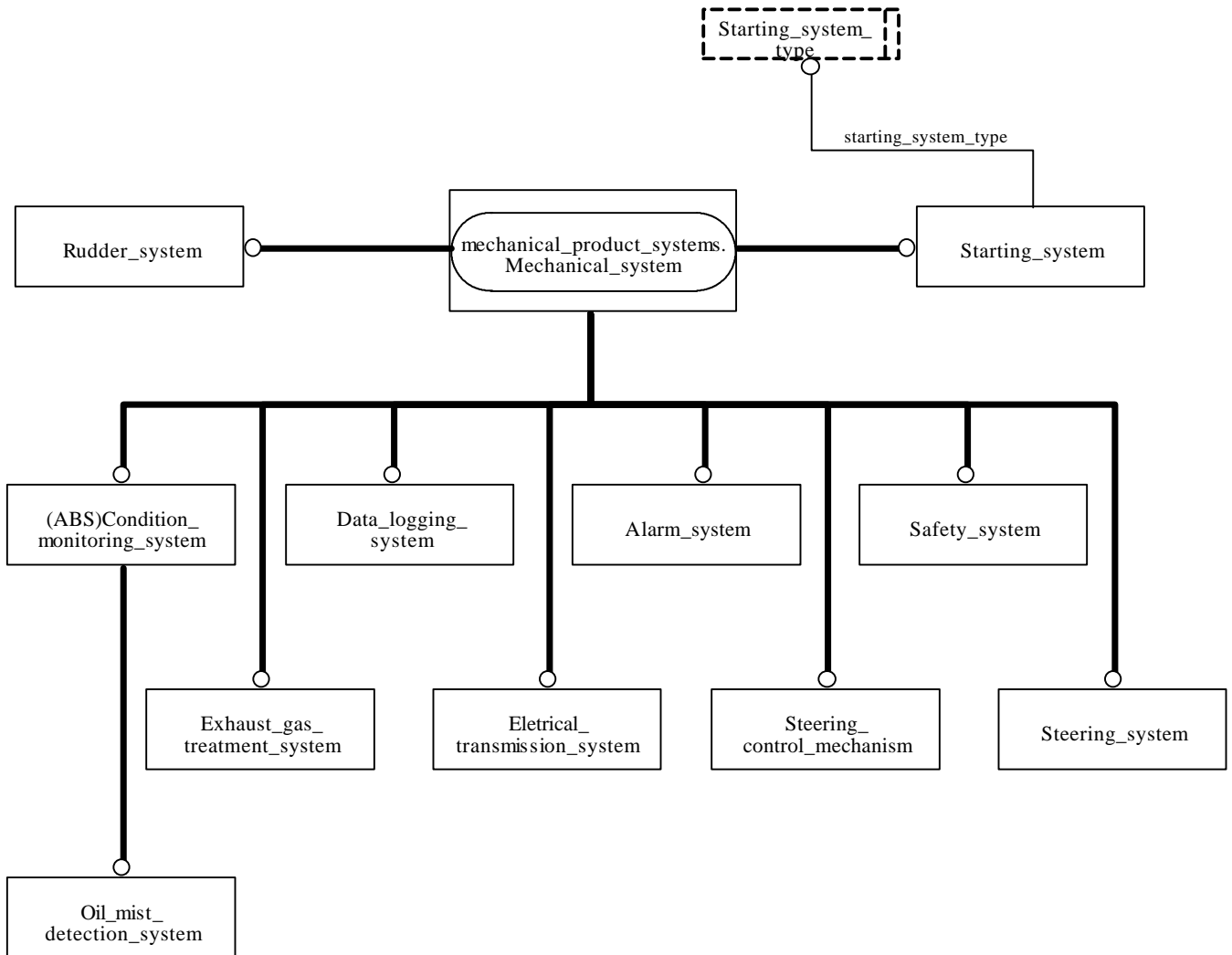


Figure G.60 - Graphical notation of the major aspects of the other_systems UoF schema (figure 1 of 1)

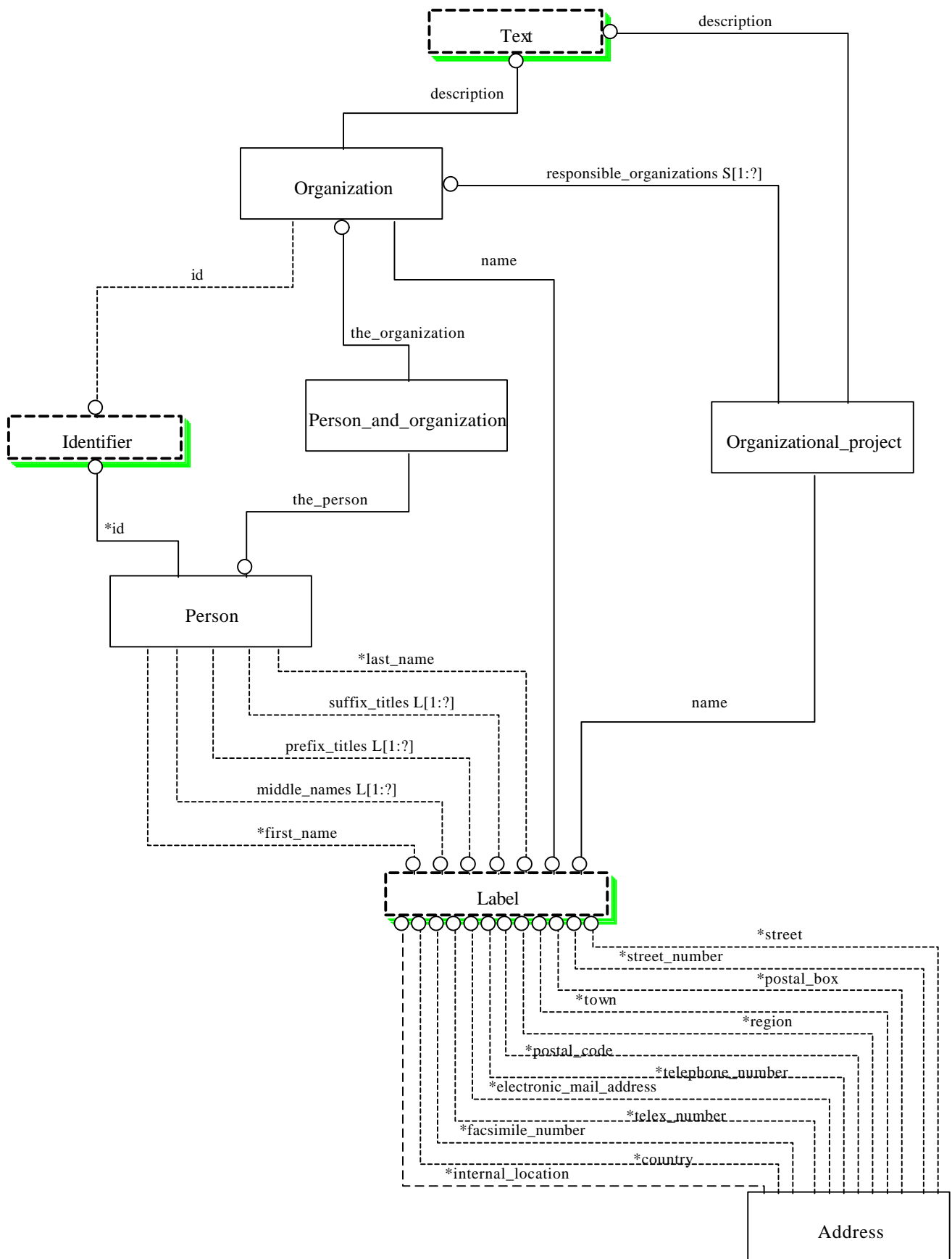


Figure G.61 - Graphical notation of the major aspects of the part41_resources UoF schema (figure 1 of 1)

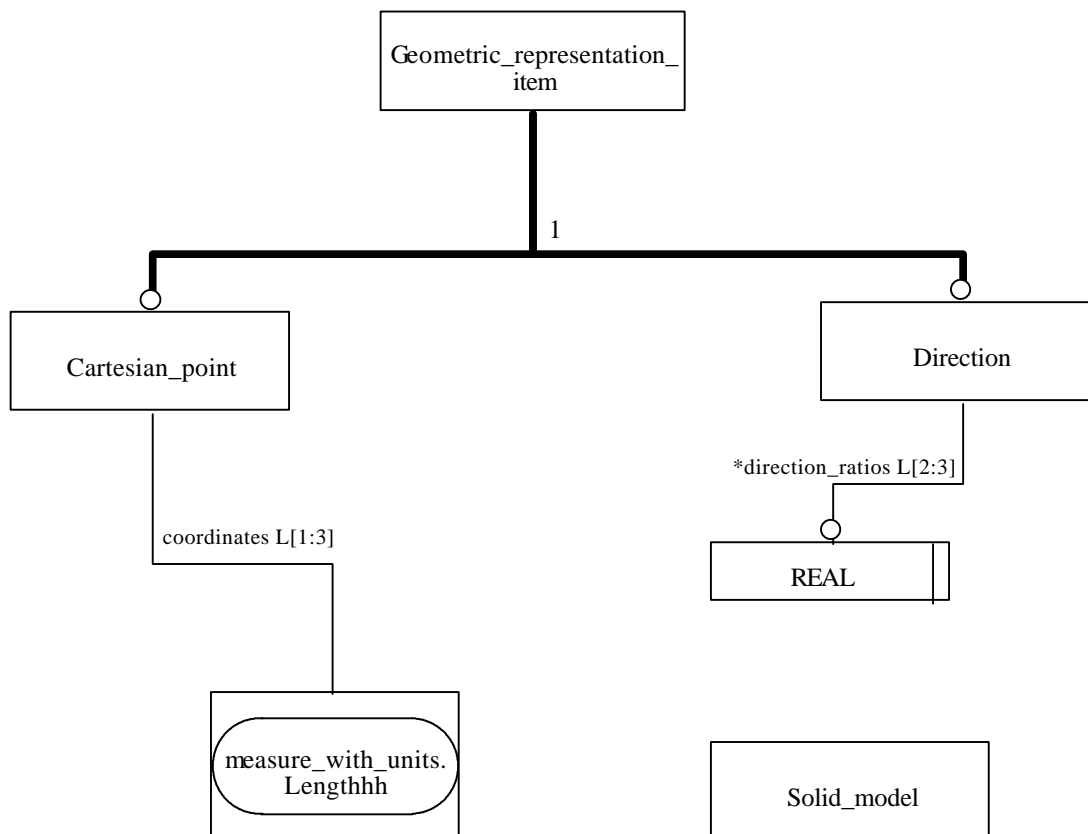


Figure G.62 - Graphical notation of the major aspects of the part42_resources UoF schema (figure 1 of 1)

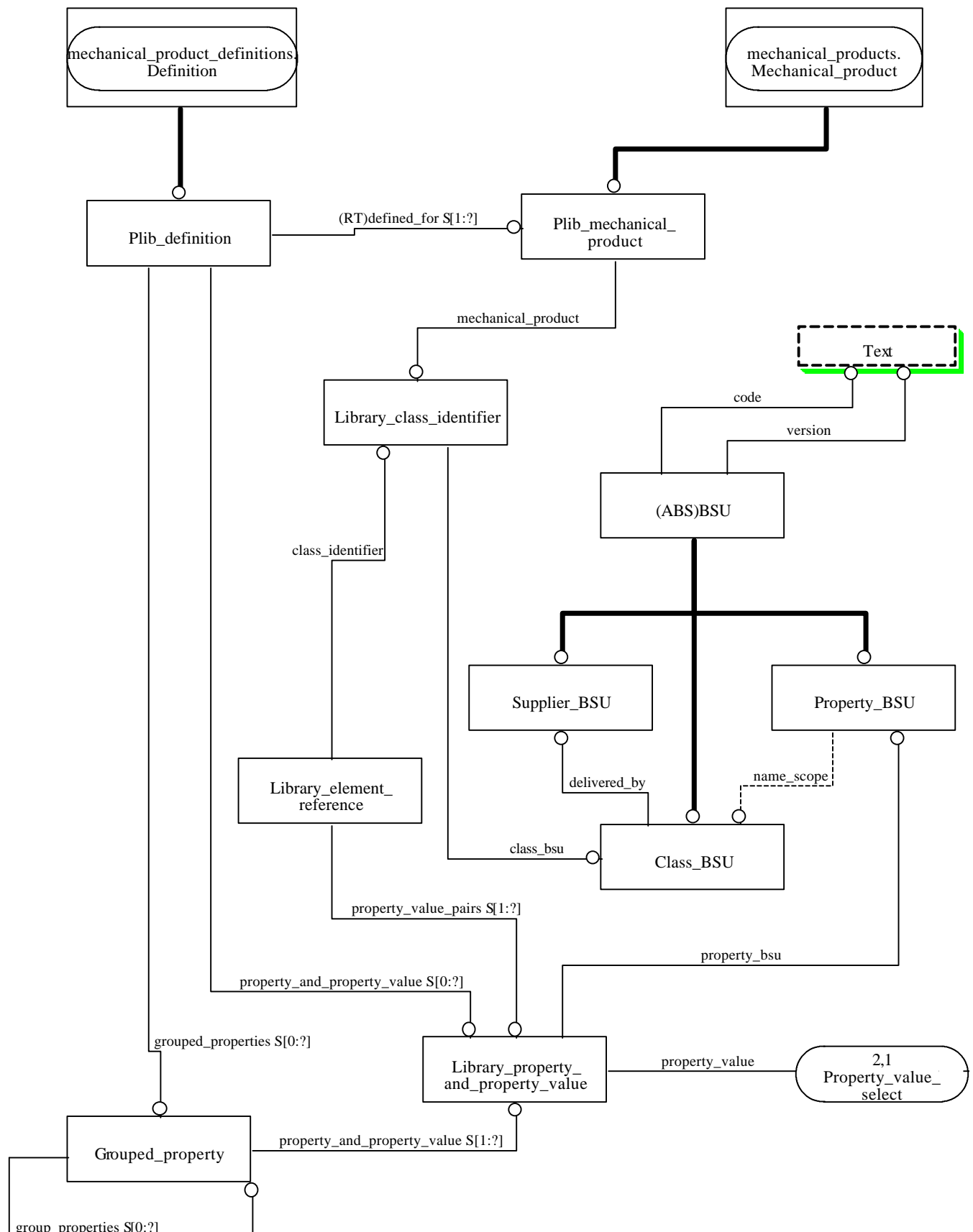


Figure G.63 - Graphical notation of the major aspects of the part_library_references UoF schema (figure 1 of 2)

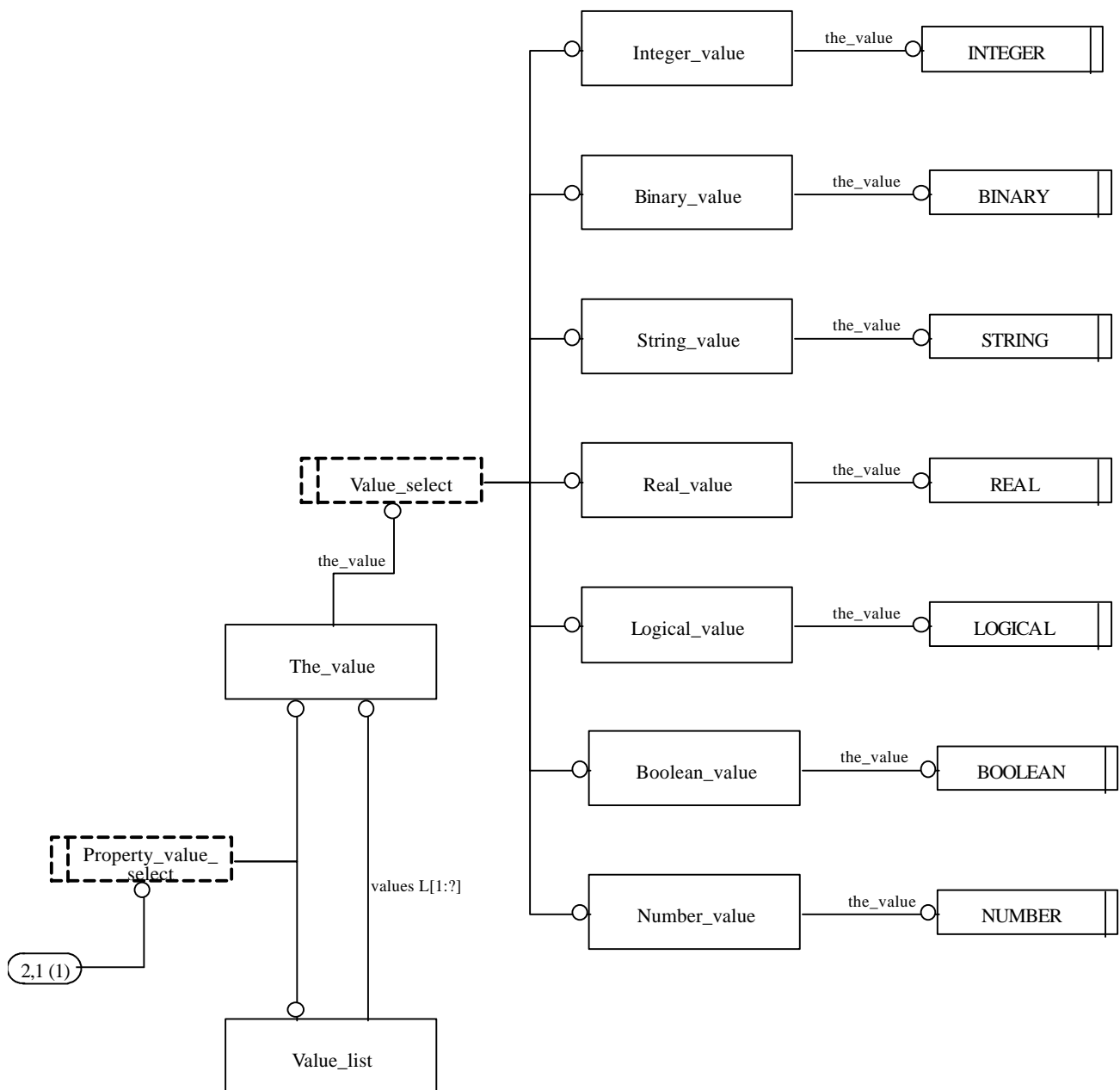


Figure G.64 - Graphical notation of the major aspects of the part_library_references UoF schema (figure 2 of 2)

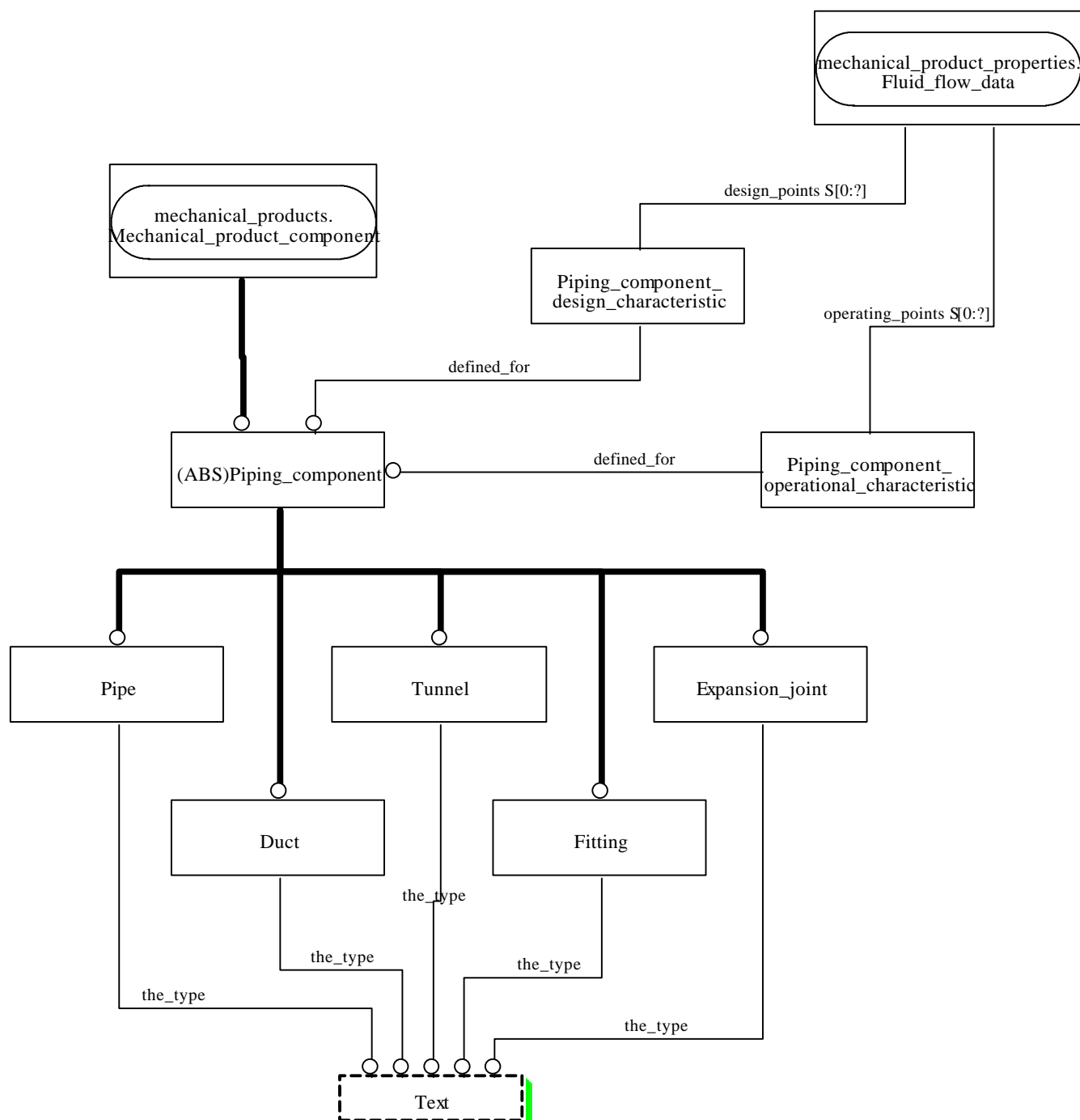


Figure G.65 - Graphical notation of the major aspects of the piping_components UoF schema (figure 1 of 1)

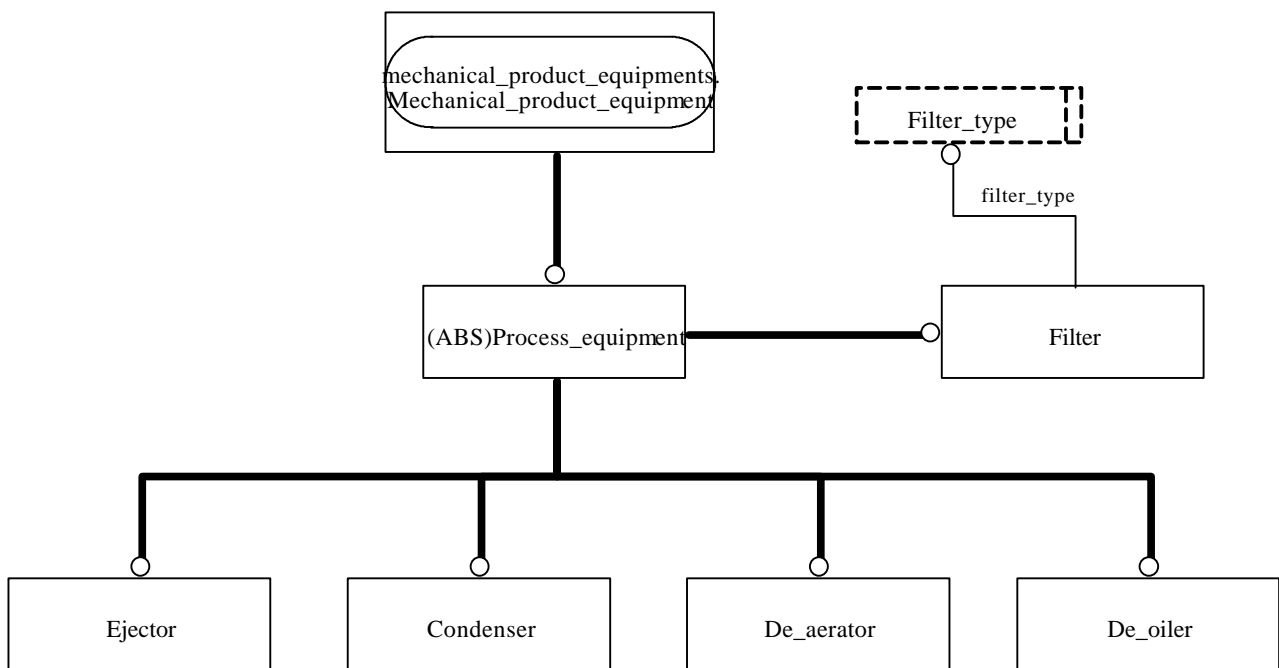


Figure G.66 - Graphical notation of the major aspects of the process equipments UoF schema (figure 1 of 1)

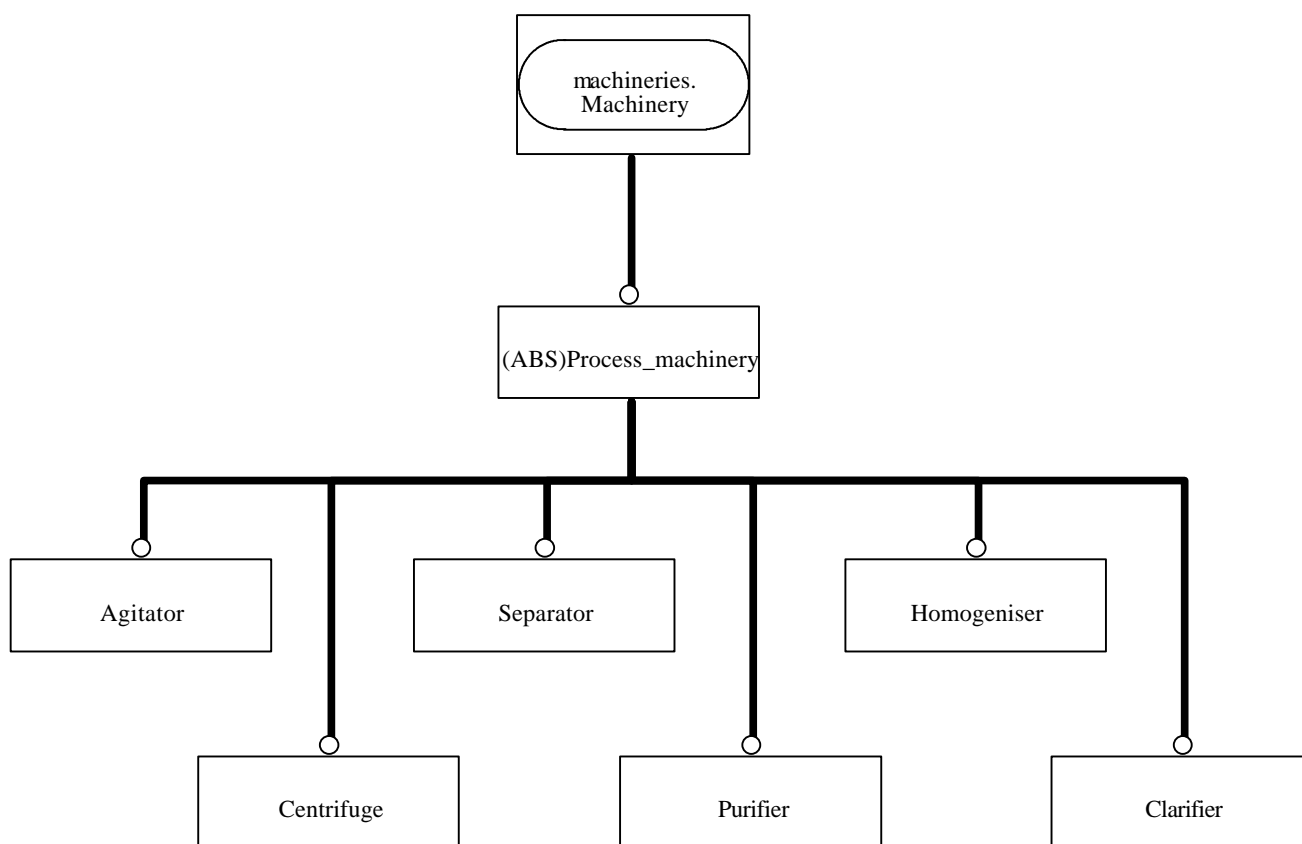


Figure G.67 - Graphical notation of the major aspects of the process_machineryes UoF schema (figure 1 of 1)

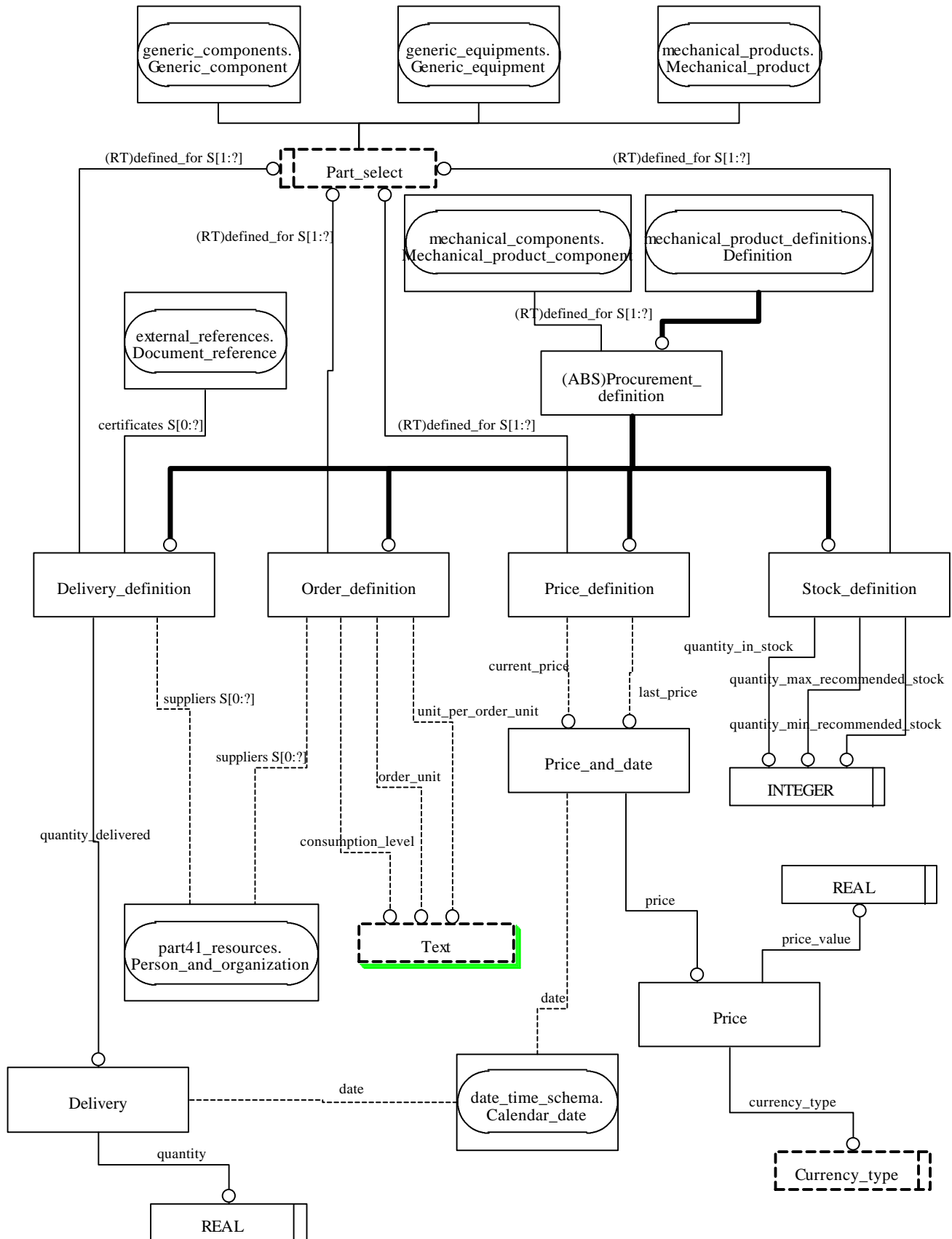


Figure G.68 - Graphical notation of the major aspects of the `procurement_definitions` UoF schema (figure 1 of 1)

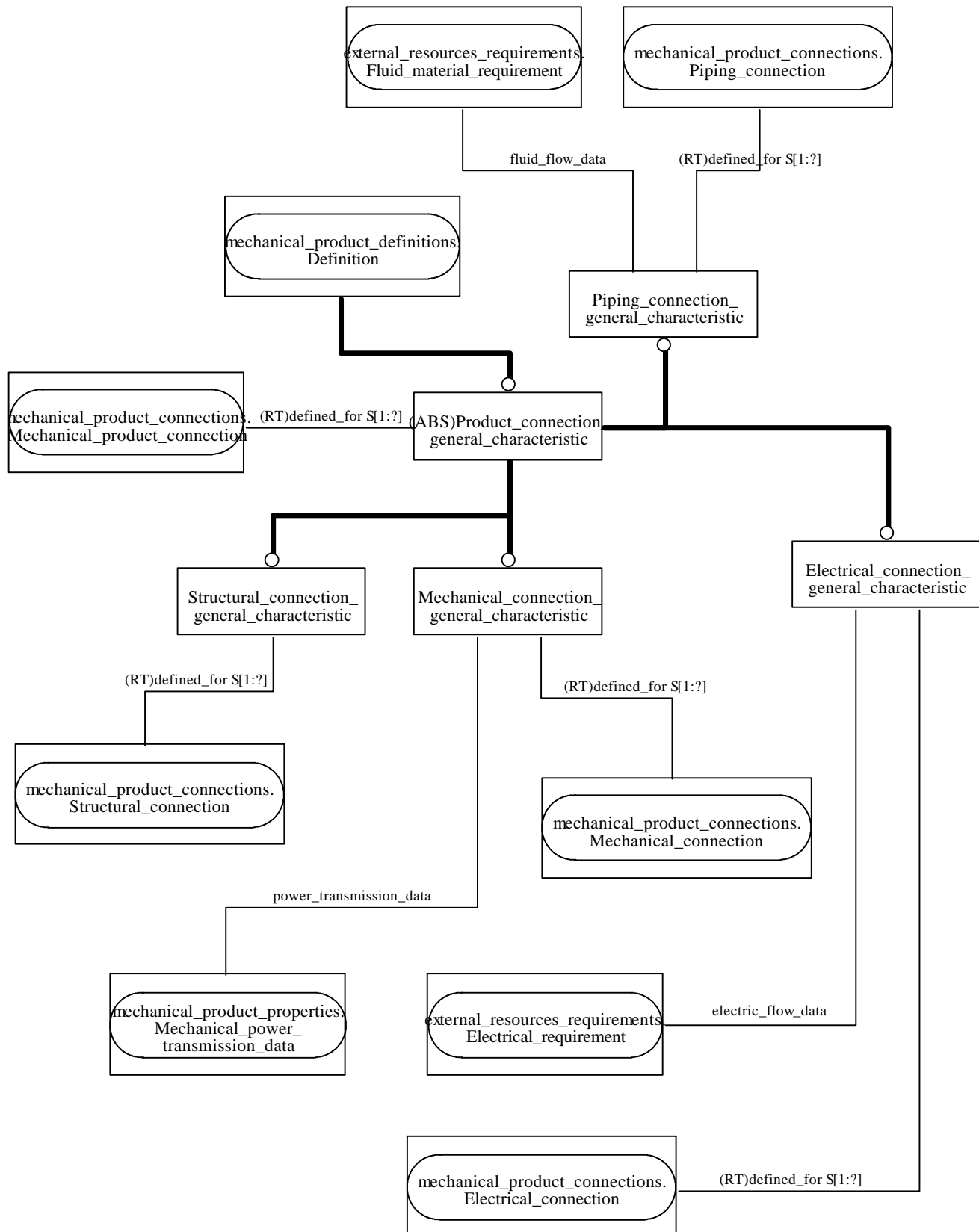


Figure G.69 - Graphical notation of the major aspects of the `product_connection_general_characteristics` UoF schema (figure 1 of 1)

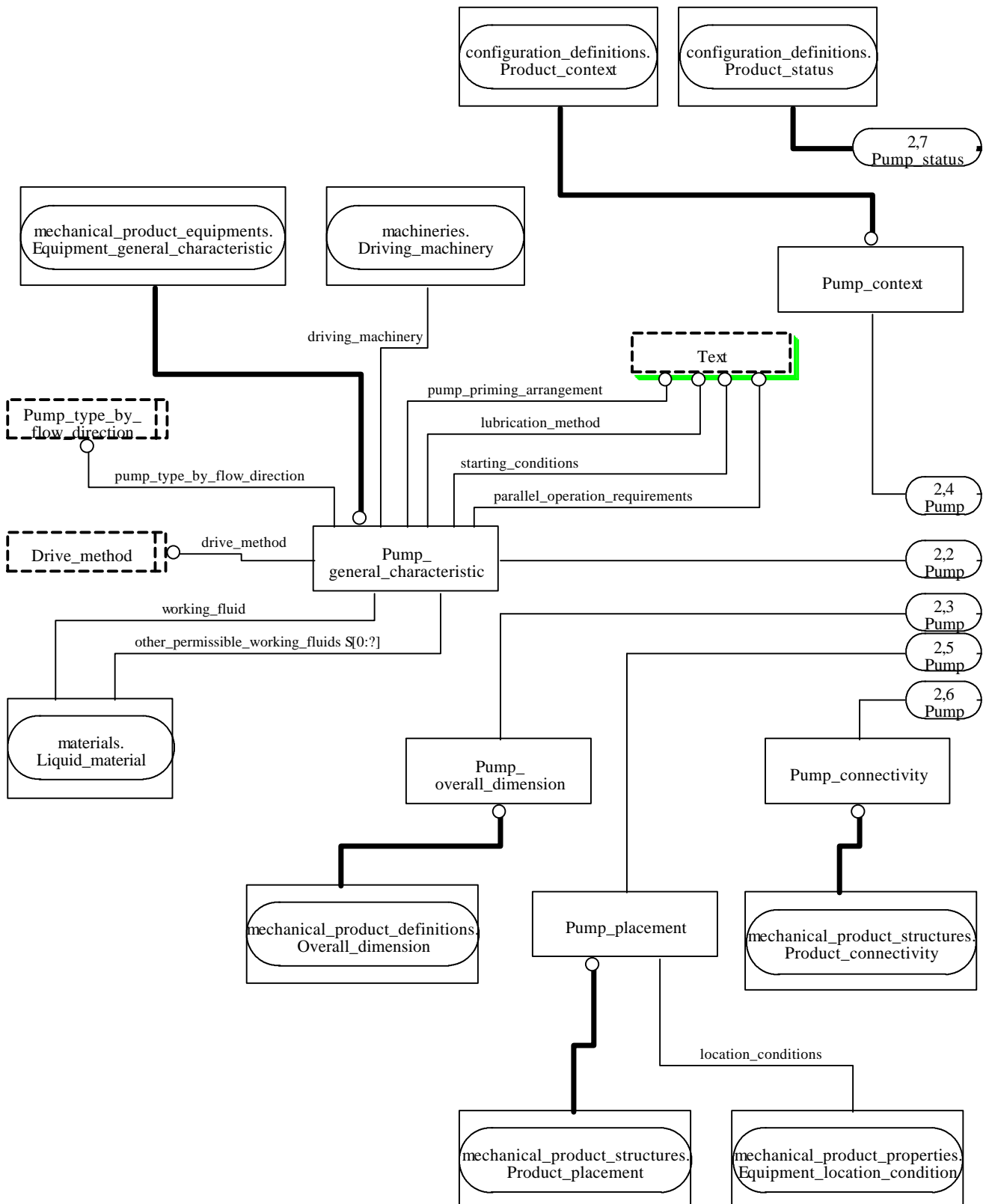


Figure G.70 - Graphical notation of the major aspects of the pumps UoF schema (figure 1 of 3)

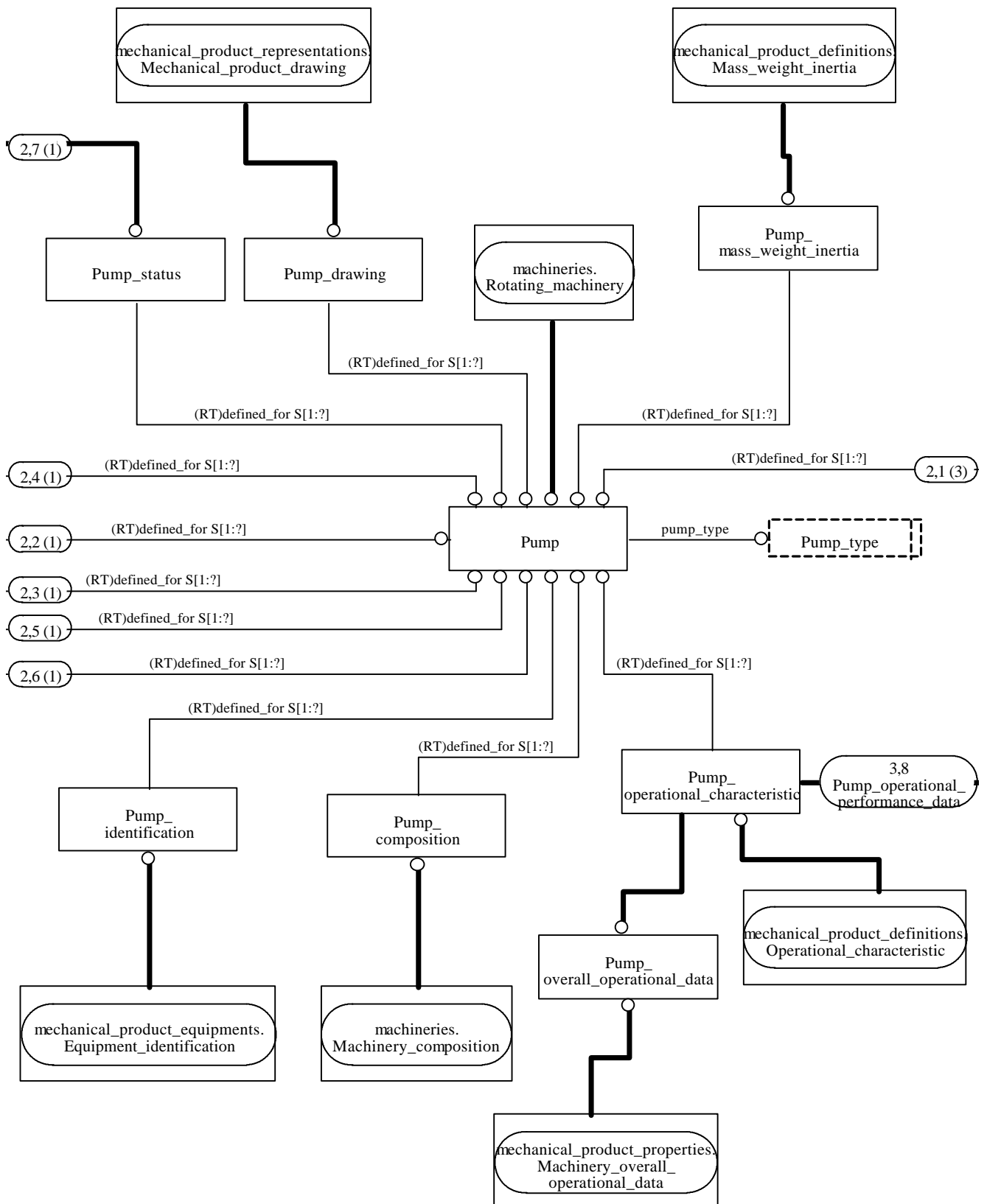


Figure G.71 - Graphical notation of the major aspects of the pumps UoF schema (figure 2 of 3)

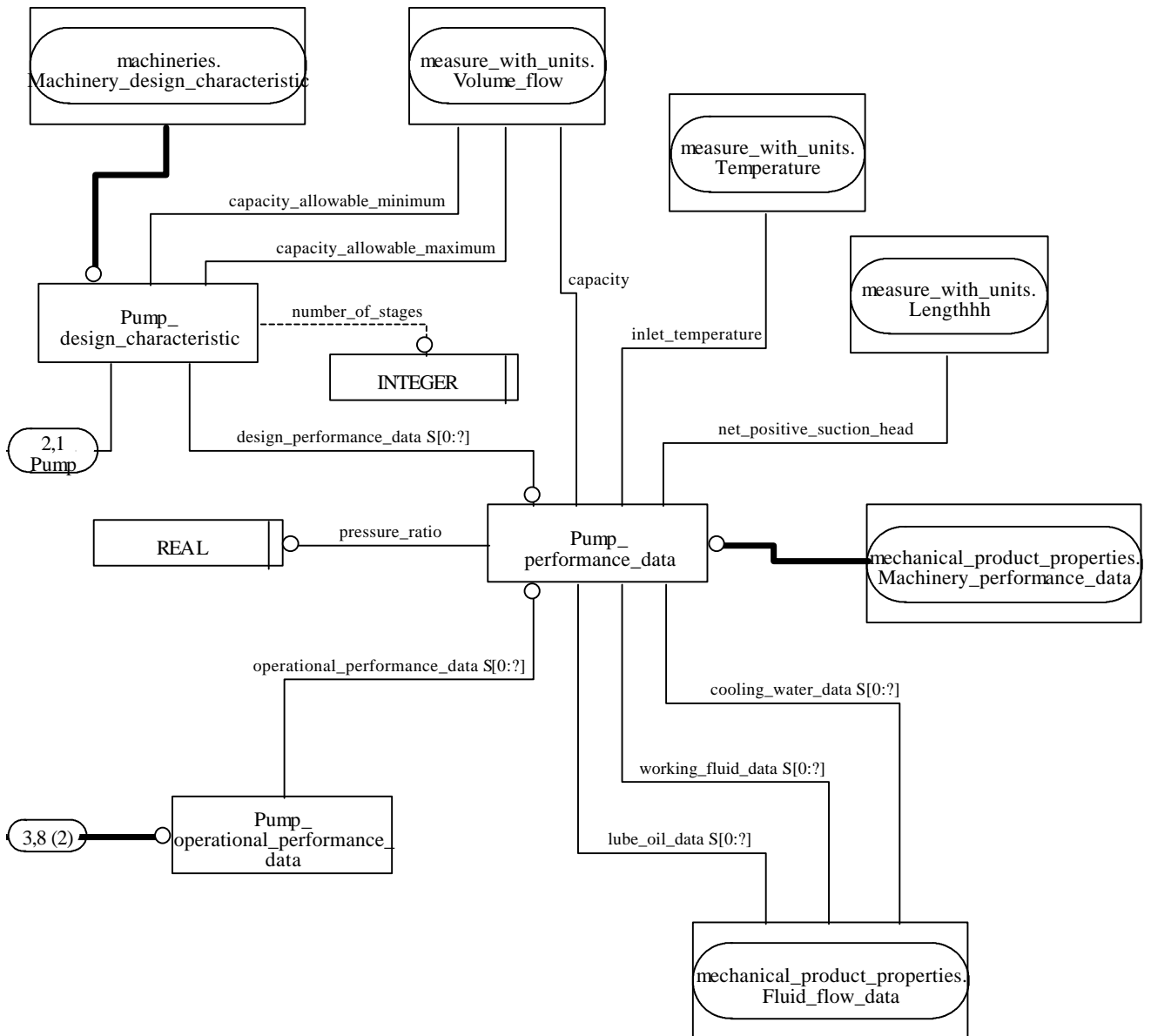


Figure G.72 - Graphical notation of the major aspects of the pumps UoF schema (figure 3 of 3)

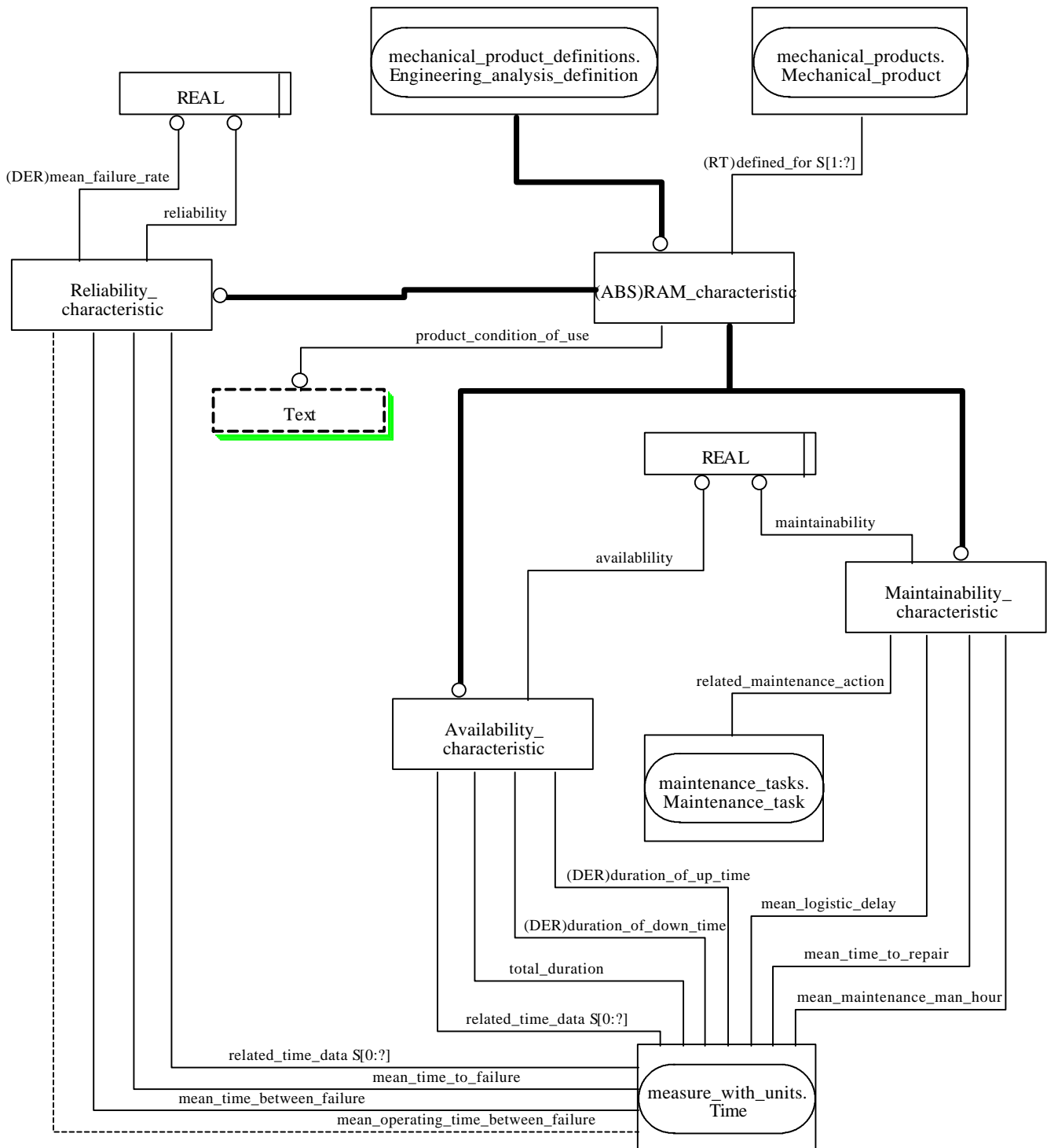


Figure G.73 - Graphical notation of the major aspects of the RAM_characteristics UoF schema (figure 1 of 1)

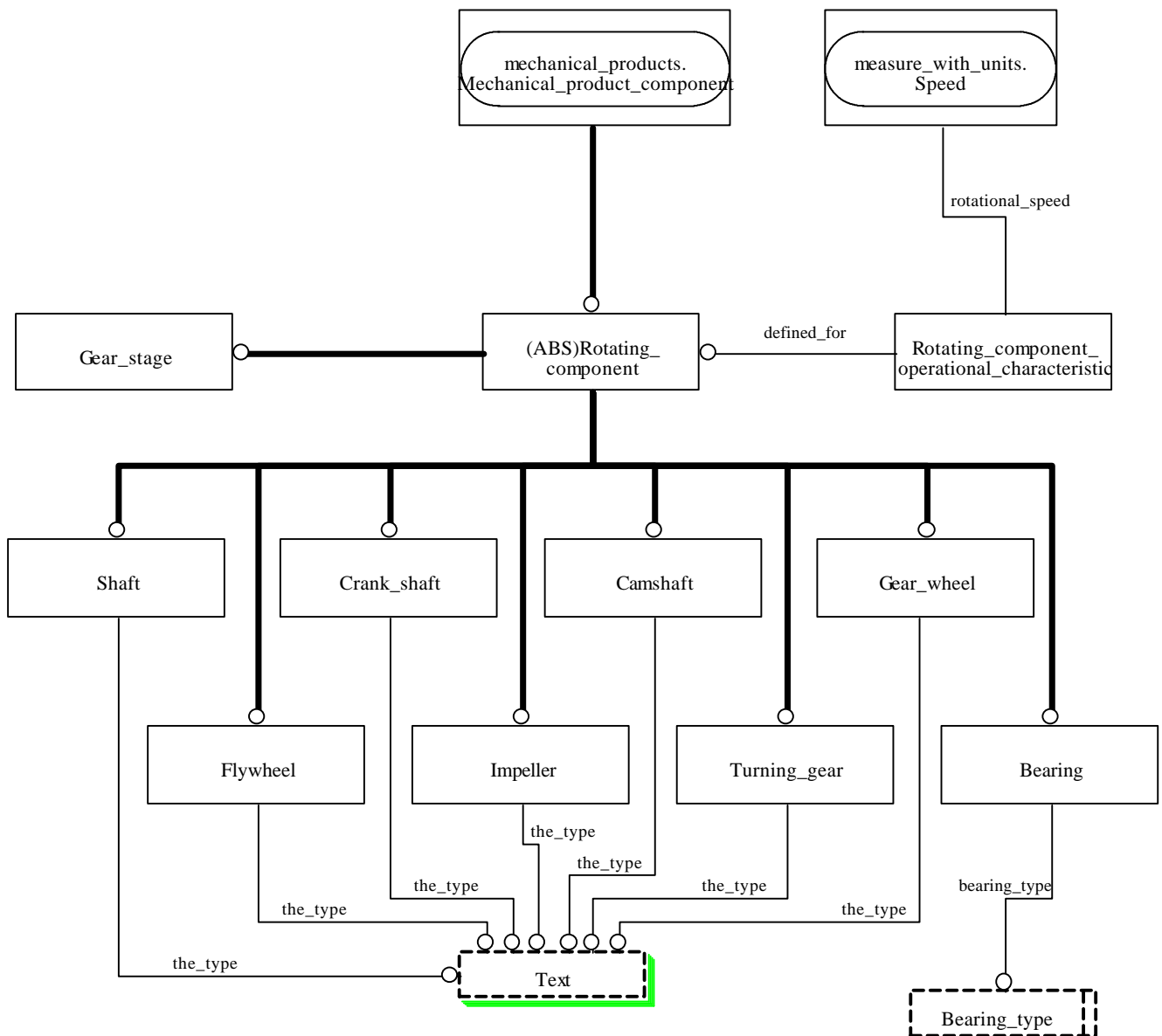


Figure G.74 - Graphical notation of the major aspects of the rotating_components UoF schema (figure 1 of 1)

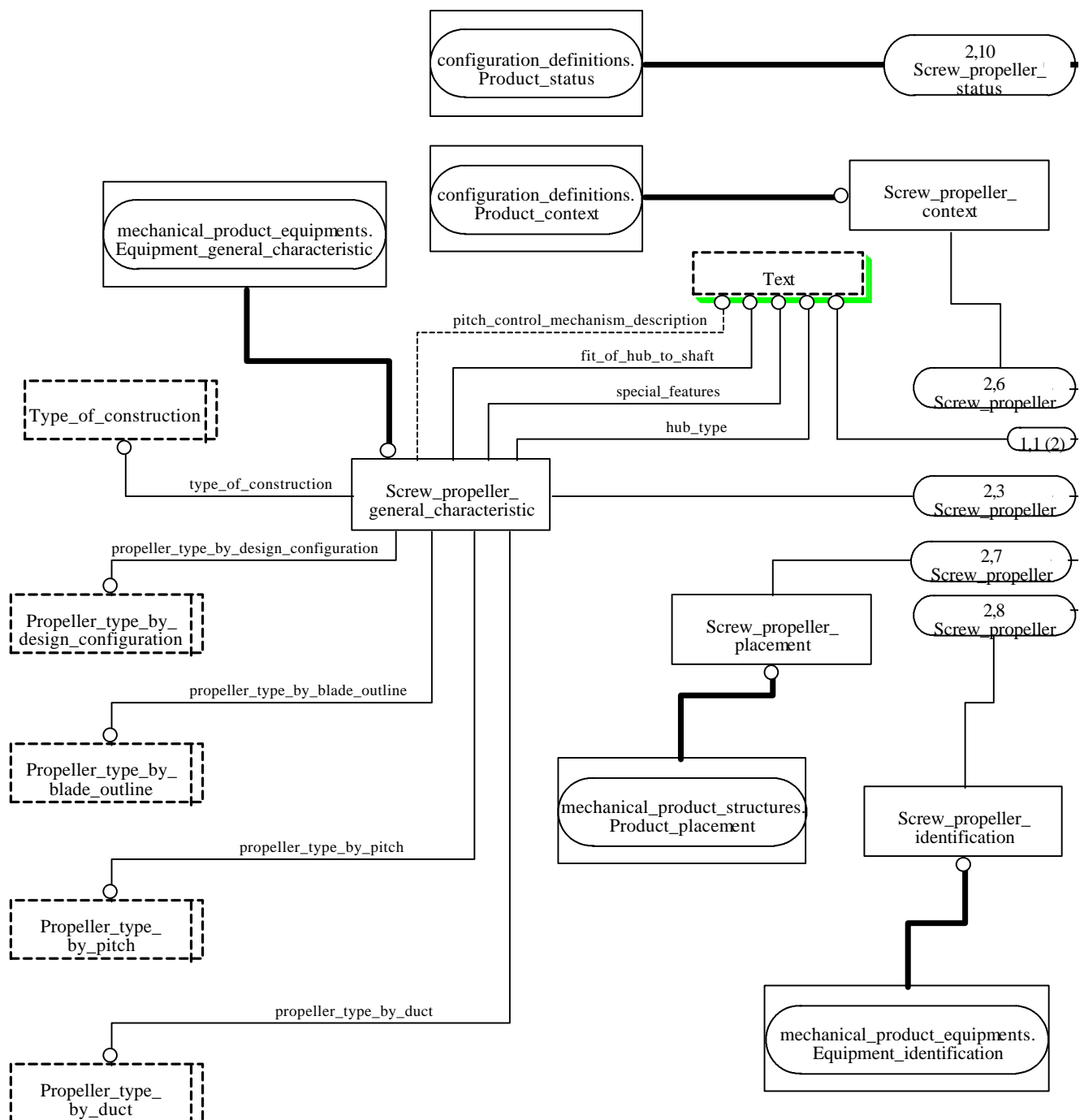


Figure G.75 - Graphical notation of the major aspects of the screw_propellers UoF schema (figure 1 of 3)

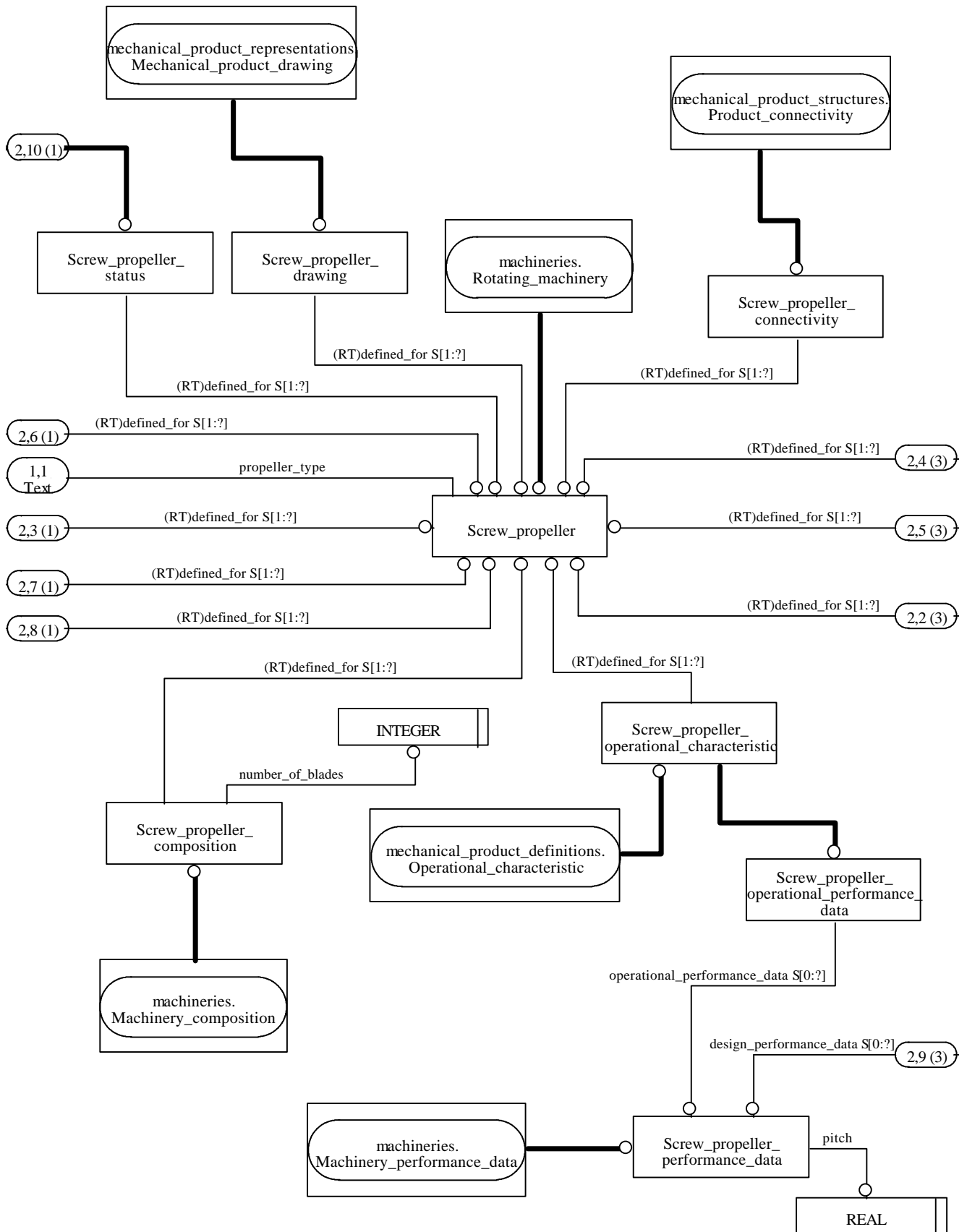


Figure G.76 - Graphical notation of the major aspects of the screw_propellers UoF schema (figure 2 of 3)

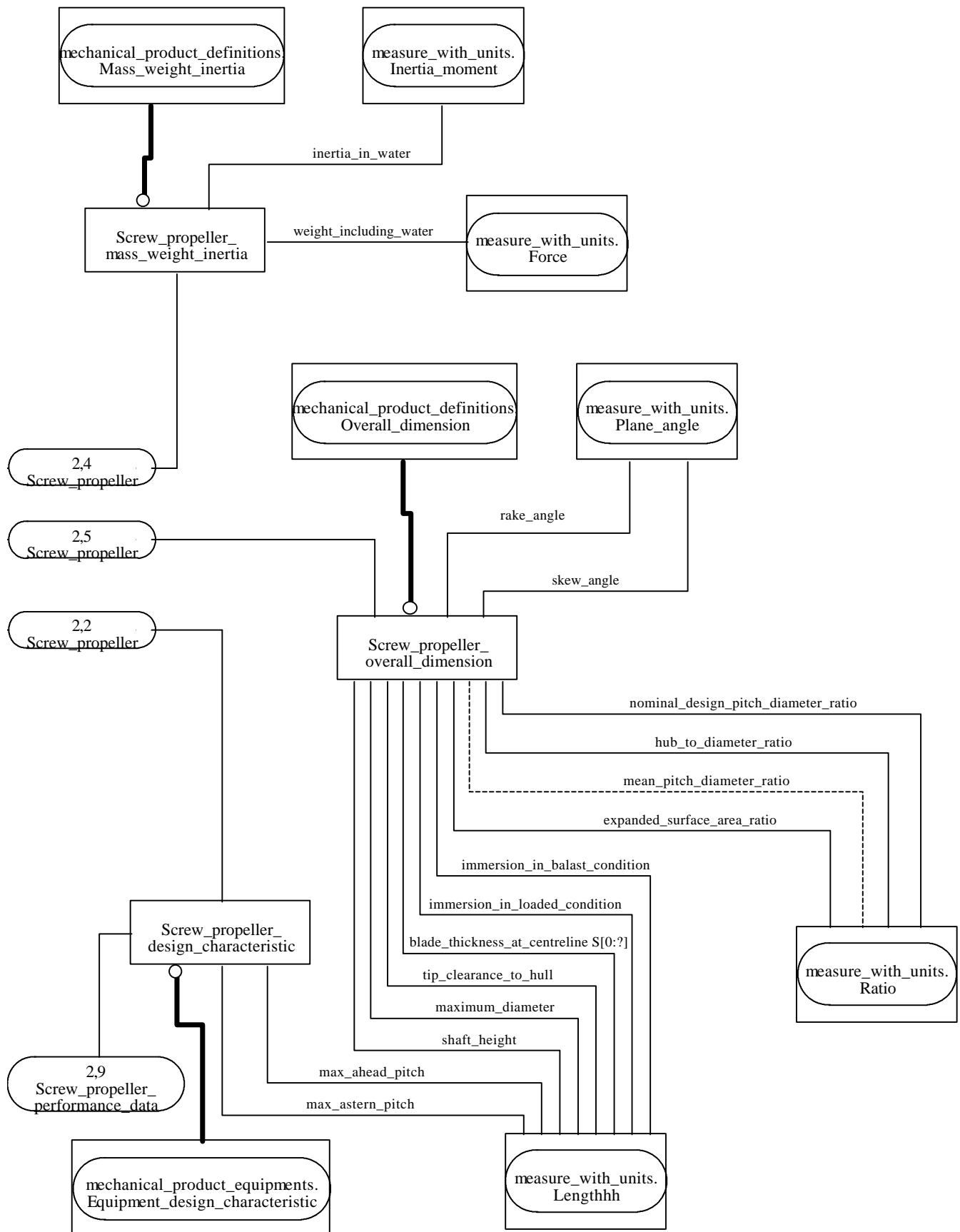


Figure G.77 - Graphical notation of the major aspects of the screw_propellers UoF schema (figure 3 of 3)

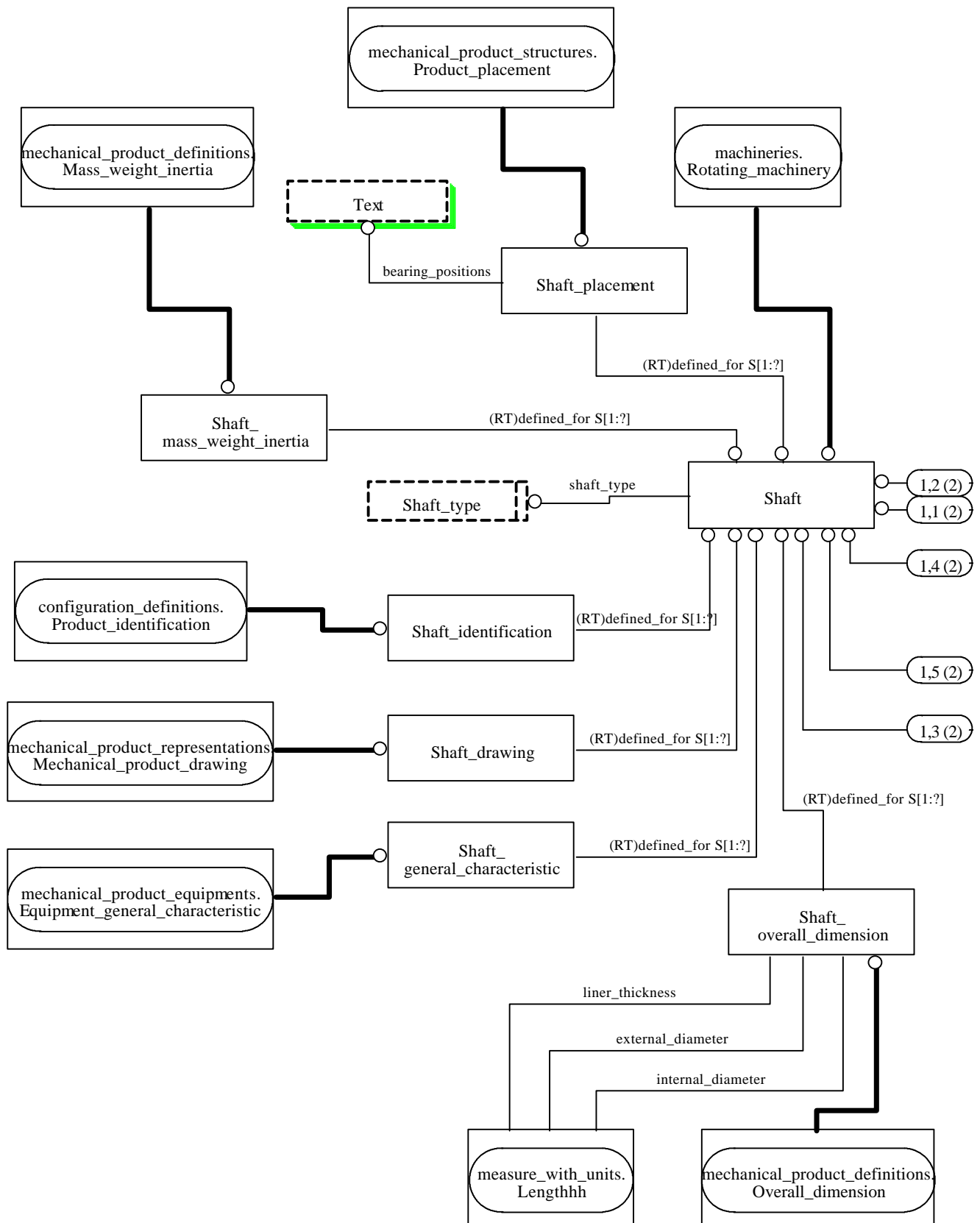


Figure G.78 - Graphical notation of the major aspects of the shafts UoF schema (figure 1 of 2)

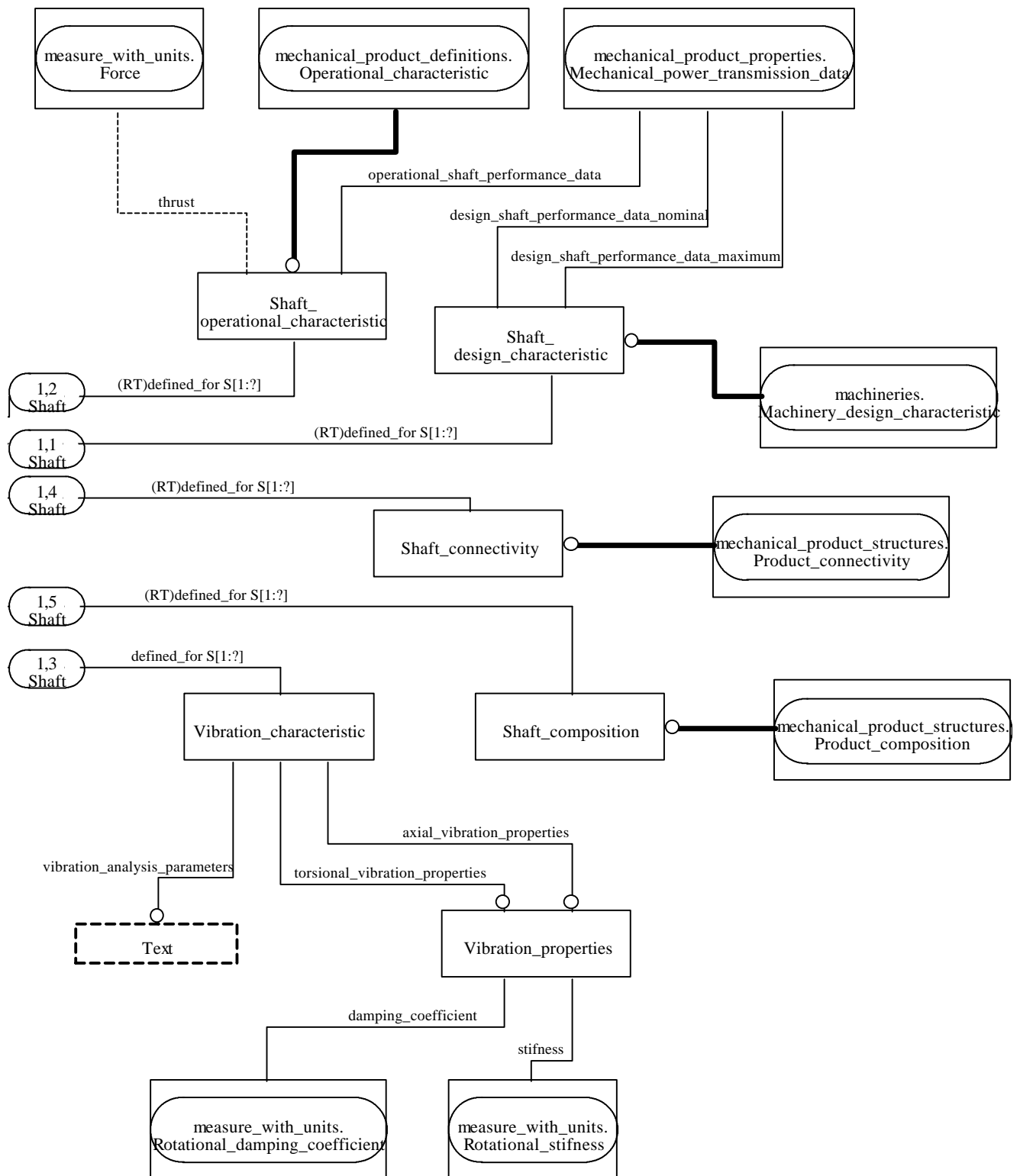


Figure G.79 - Graphical notation of the major aspects of the shafts UoF schema (figure 2 of 2)

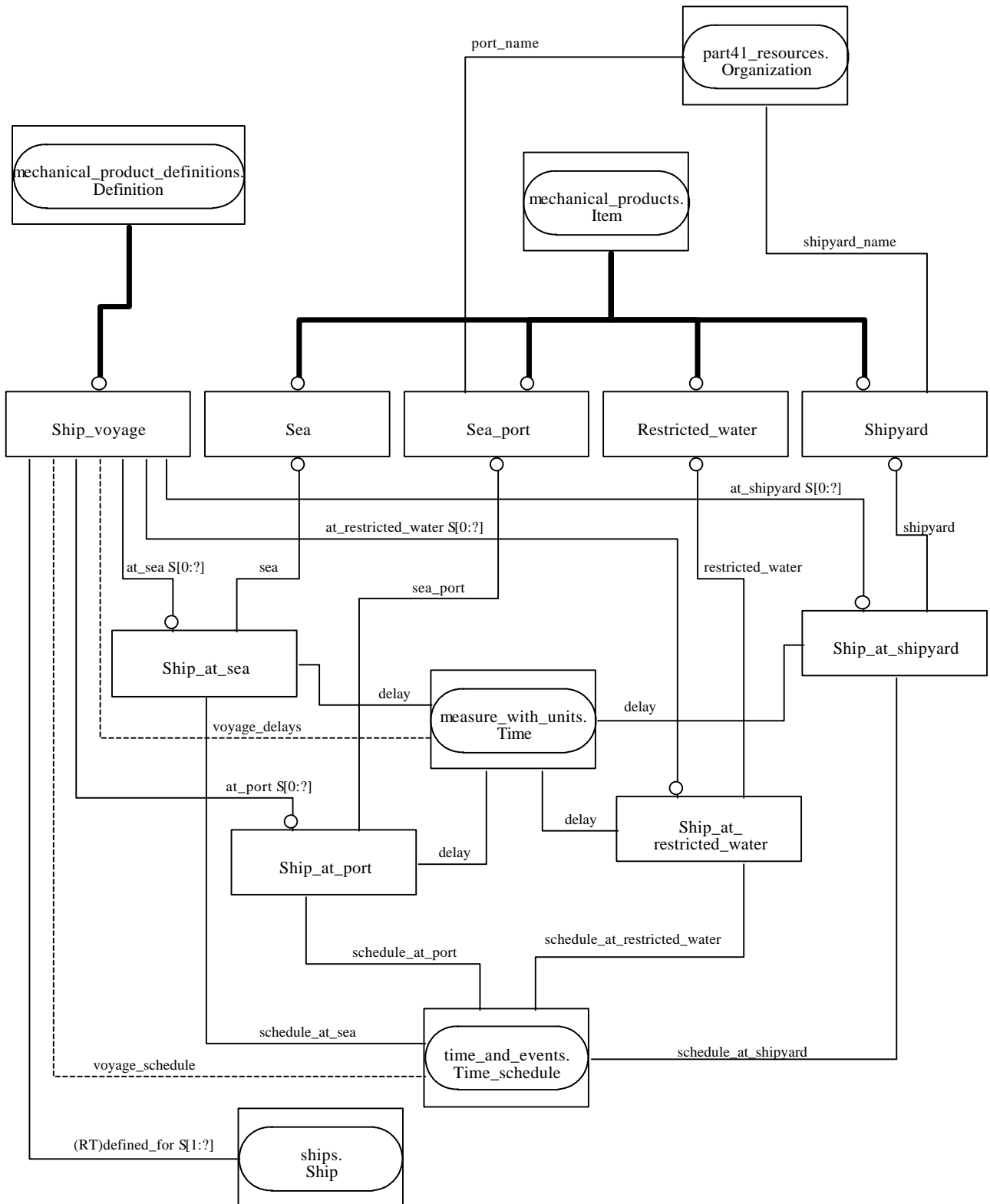


Figure G.80 - Graphical notation of the major aspects of the ship_voyages UoF schema (figure 1 of 1)

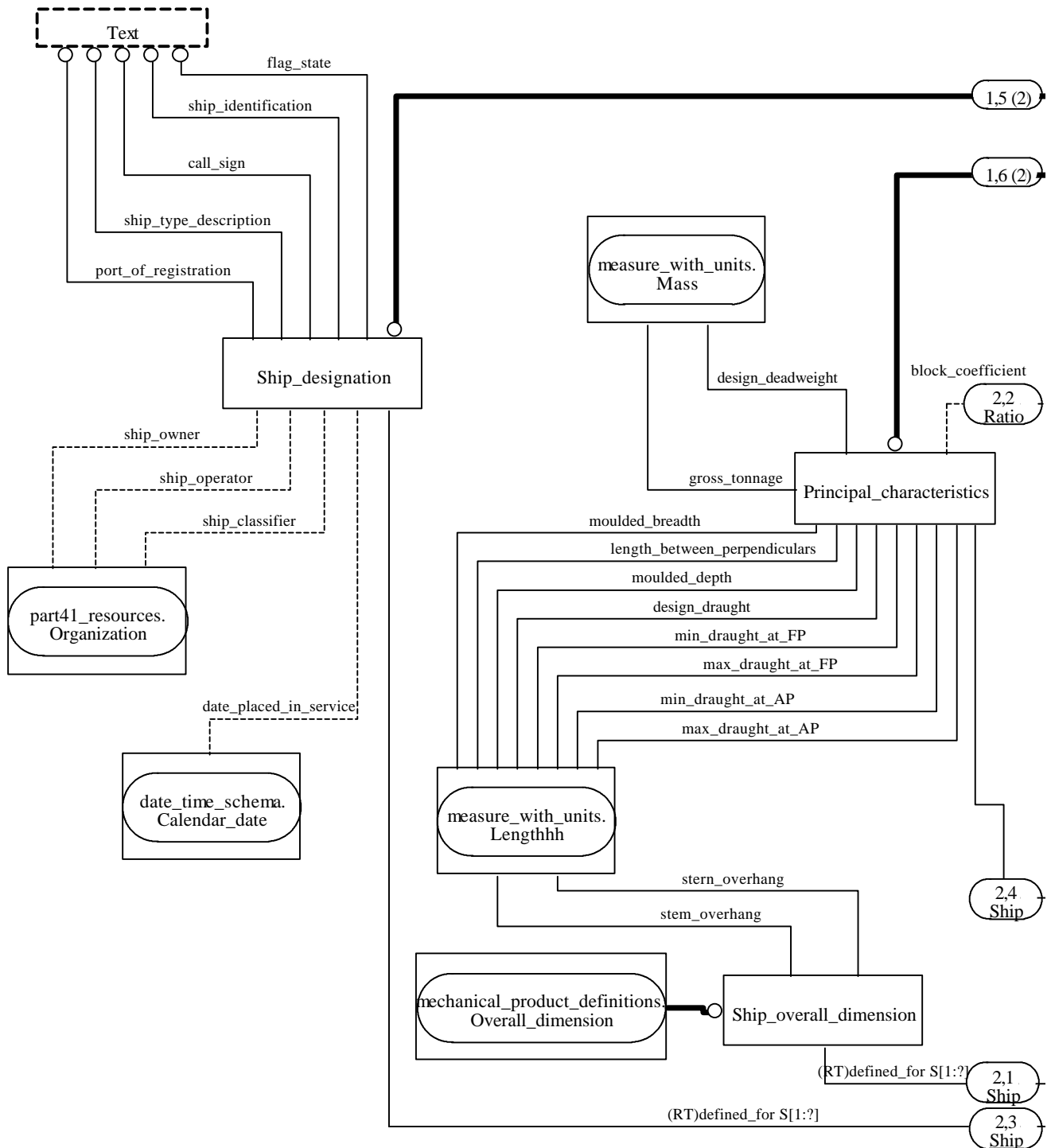


Figure G.81 - Graphical notation of the major aspects of the ships UoF schema (figure 1 of 2)

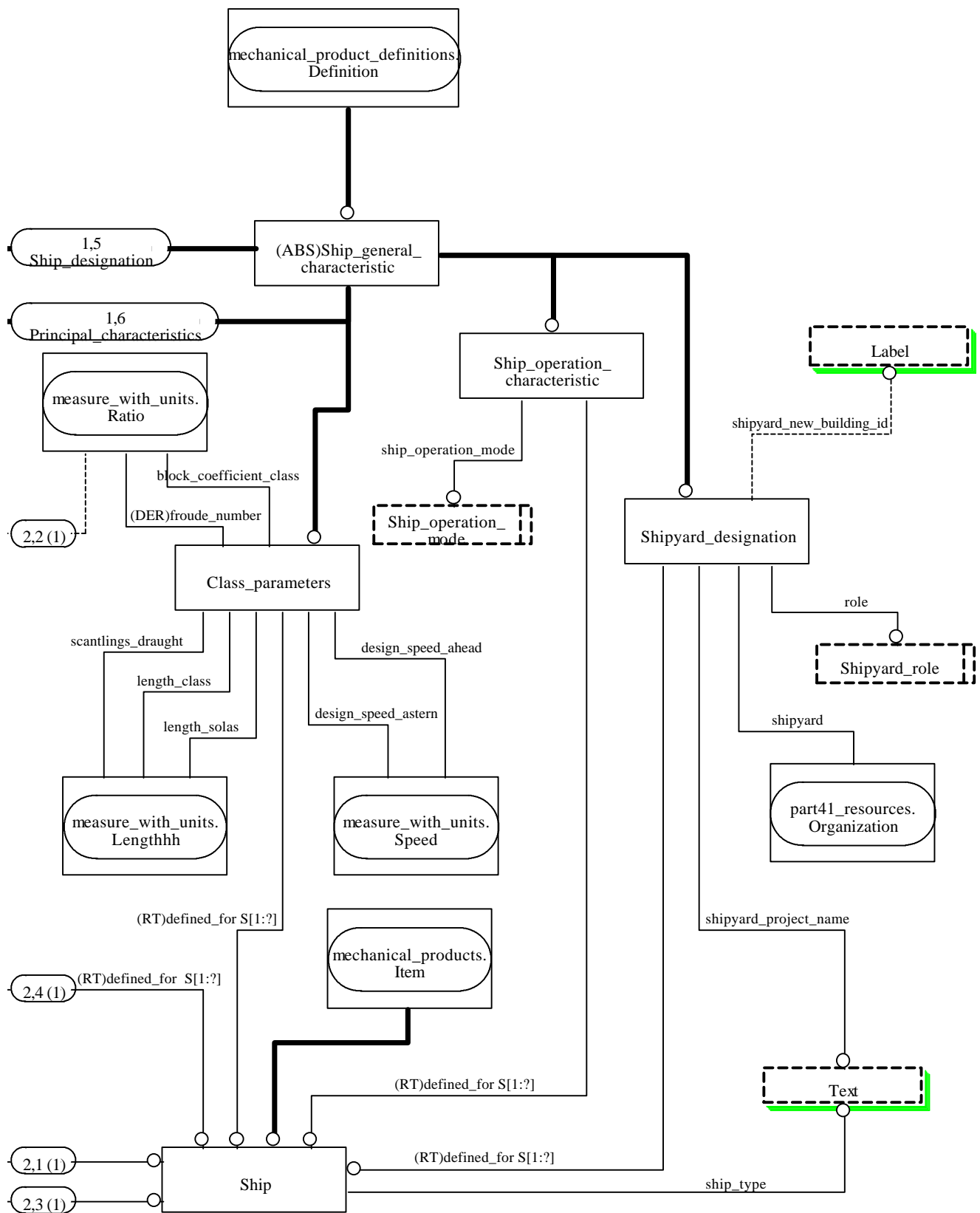


Figure G.82 - Graphical notation of the major aspects of the ships UoF schema (figure 2 of 2)

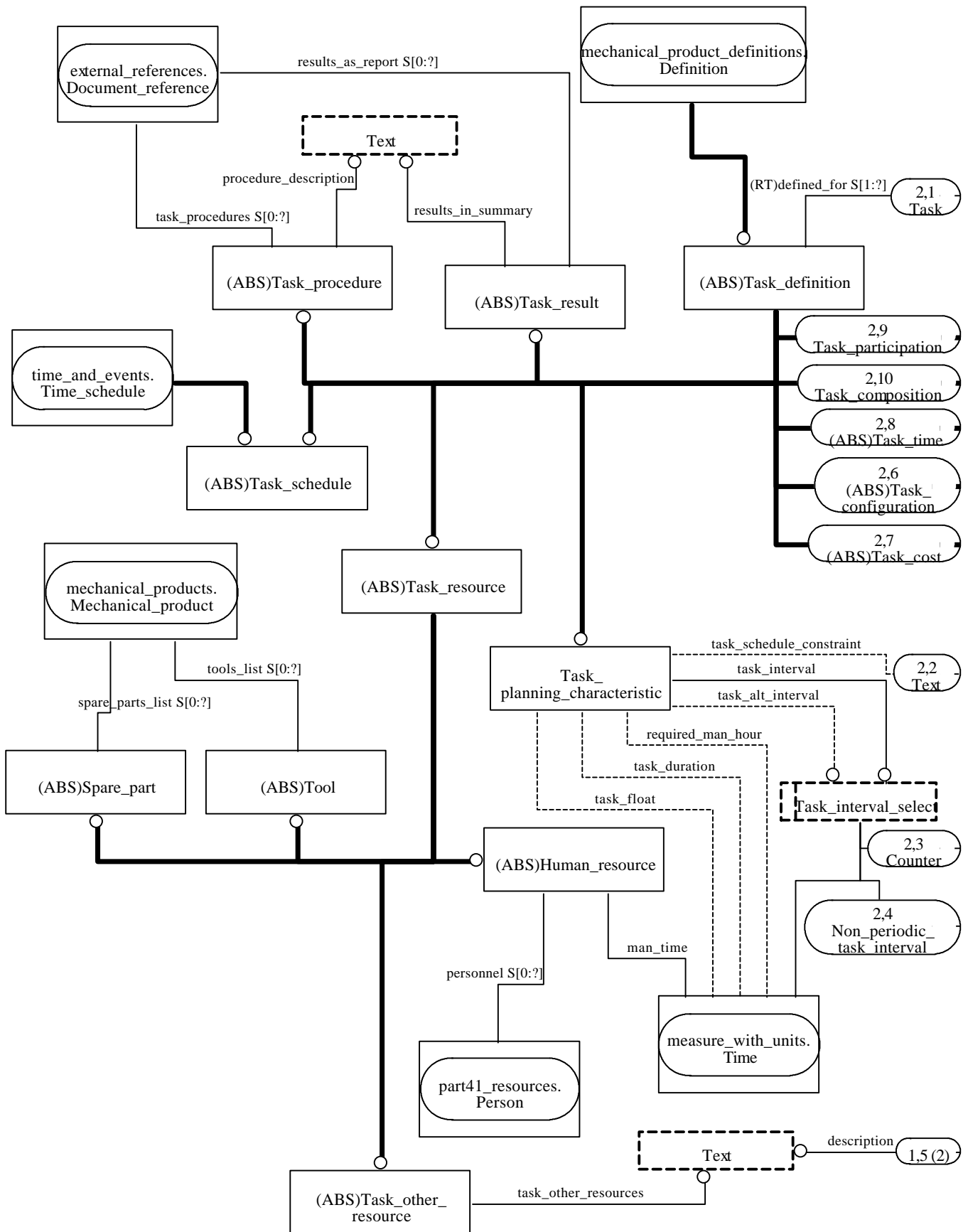


Figure G.83 - Graphical notation of the major aspects of the task_definitions UoF schema (figure 1 of 2)

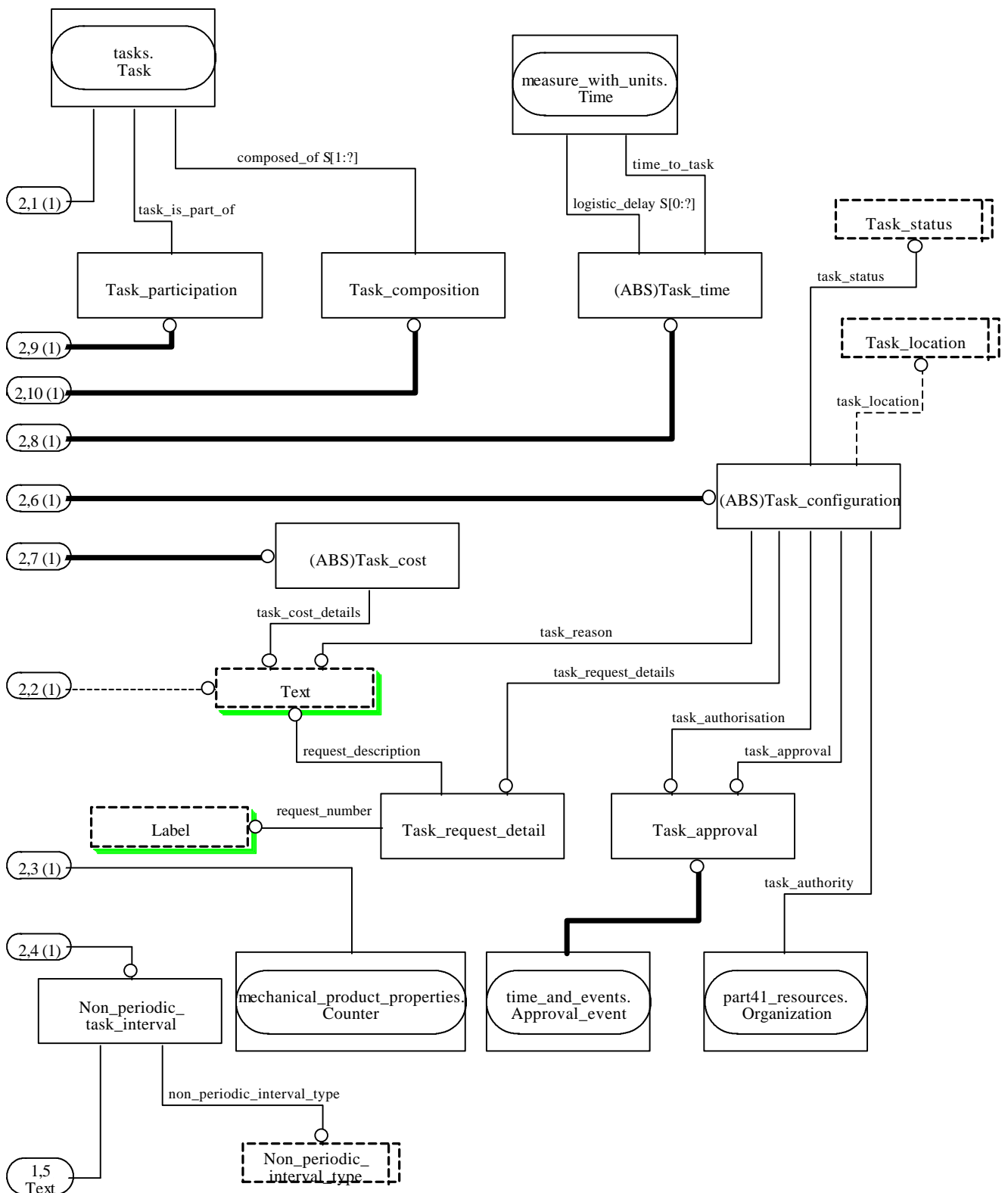


Figure G.84 - Graphical notation of the major aspects of the task_definitions UoF schema (figure 2 of 2)

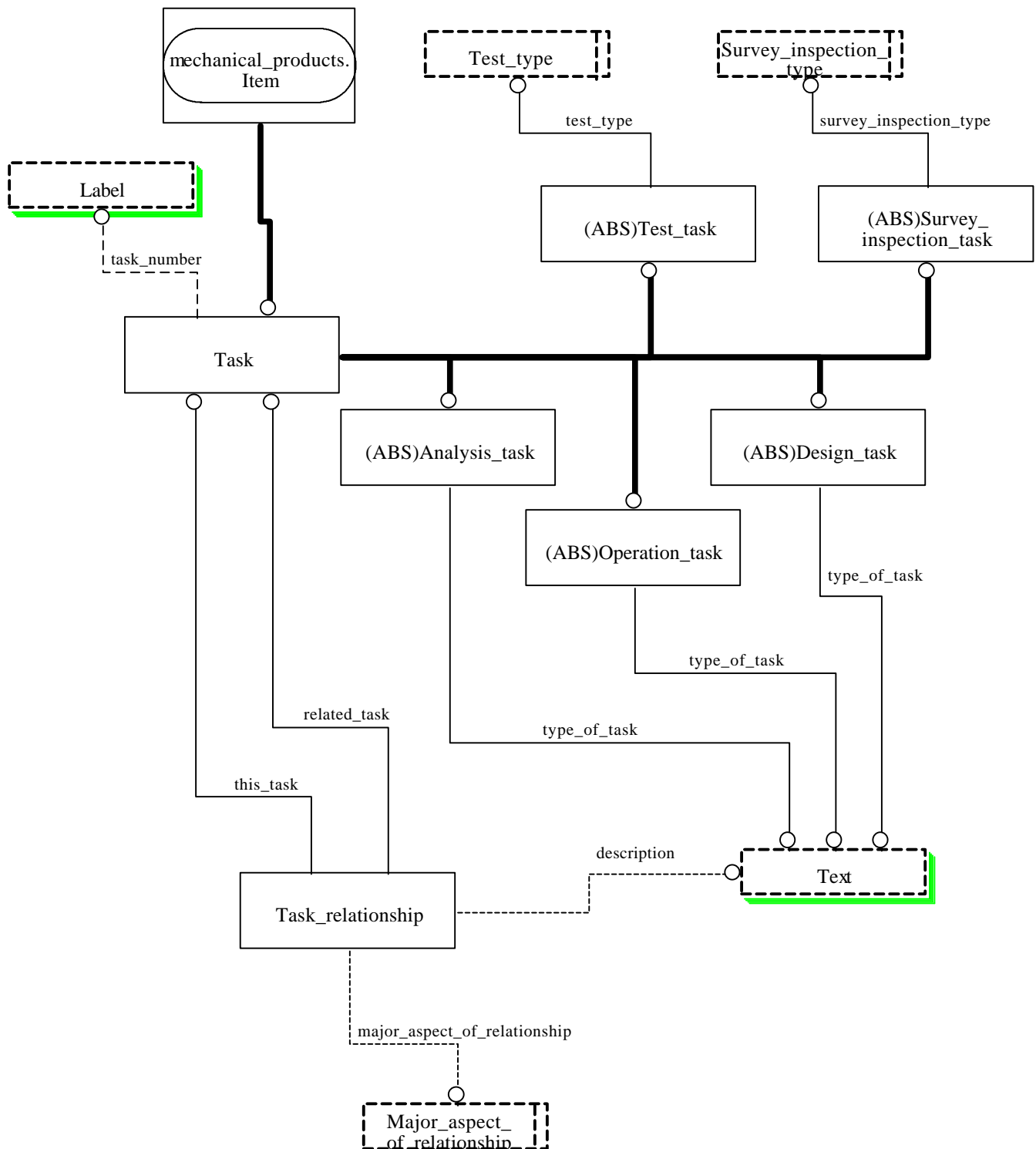


Figure G.85 - Graphical notation of the major aspects of the tasks UoF schema (figure 1 of 1)

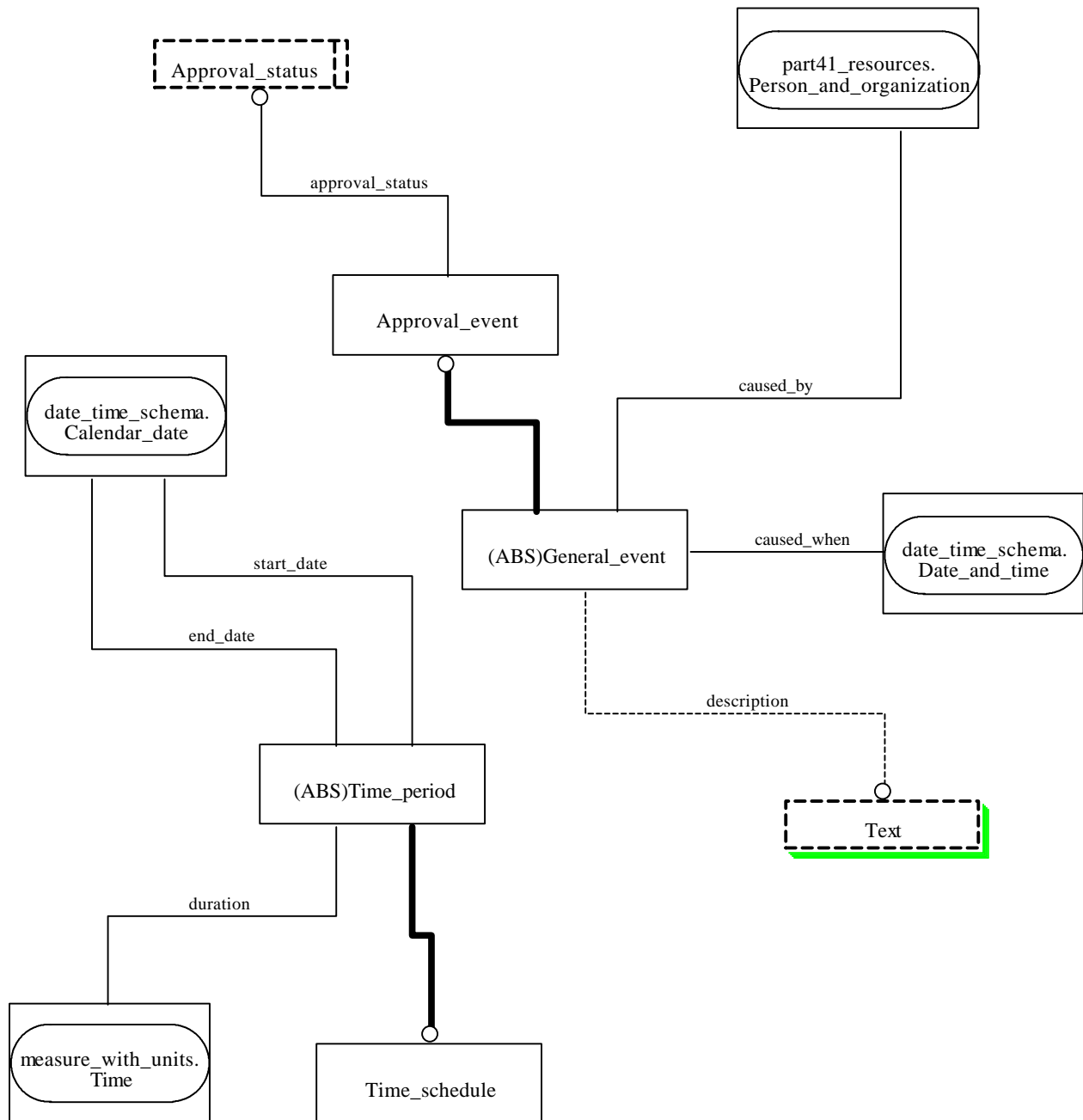


Figure G.86 - Graphical notation of the major aspects of the `time_and_events` UoF schema (figure 1 of 1)

Annex H
(informative)

AIM EXPRESS-G

To be completed at a later date.

Annex J
(informative)

AIM EXPRESS listing

To be completed at a later date.

Annex K
(informative)

Bibliography

1. NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY; *Integration Definition for Functional Modelling (IDEFO)* 21st December 1993, National Institute of Standards and Technology Draft Federal Processing Standards Publication 183.

Annex L
(informative)
Technical discussion

L.1 Introduction

This annex has been prepared in order to provide the general and introductory information on technical methodology adopted within this part of ISO 10303. This annex describes the following:

1. An introduction to STEP and ship product related Application Protocols with special reference to Part 226 on Ship Mechanical Systems.
2. Concepts common to all ship product Application Protocols, including type hierarchies related to concept of item, definitions and association of definitions to item.
3. Architecture of AP226 data model including the AP226 data planning model and description of how the full scope of AP226 is embodied in the data model.

The expected audience of this annex are those who intend to either review this part of ISO 10303 or subsequently use and implement this standard.

L.2 STEP and Ship Application Protocols

L.2.1 What is Step?

The STEP initiative was officially begun in 1984 as a means of facilitating concurrent engineering within the manufacturing industry. STEP is the widely used name for **ISO 10303 - Product Data Representation and Exchange** and is being developed under the guidance of the ISO Technical Sub-Committee **TC184/SC4**.

The aim of STEP, the STandard for the Exchange of Product model data, is the complete and unambiguous representation of a product such as a ship, a car, or an airplane, throughout its lifetime, in a computer interpretable neutral format. As such, the STEP initiative is directed towards enabling a product to be consistently represented from the requirement definition stage of its life, through the conceptual design, production and through-life operation and maintenance stages and then finally into the decommissioning phases. The ability to define data will enable organizations to reuse, exchange and share data to mutual advantage. With so much variety, it would be easy for STEP to be too complex to be useful. To avoid this, the STEP standard has user specific parts, each of which describes:

- The standard data definitions for that particular application area.
- How that data will be exchanged or shared

These parts are known as **Application Protocols (AP)**.

L.2.2 The STEP Ship Model

The STEP ship model is a subset of the wider ISO STEP initiative. It currently comprises five application protocols which are under development. These are:

AP215	Ship Arrangements	AP218	Ship Structures
AP216	Ship Moulded Forms	AP226	Ship Mechanical Systems
AP217	Ship Piping Systems		

The above series of ship product application protocols assumes that the ship as a product can be divided into separate ship systems such that each covers a key element of the ship for its entire life cycle. These key systems are: ship moulded forms, ship arrangements, ship distribution systems (piping, heating, ventilation and air conditioning, and electrical/cableway), ship structure, ship mechanical systems, ship outfit and furnishing, and ship mission systems (see Figure L.1).

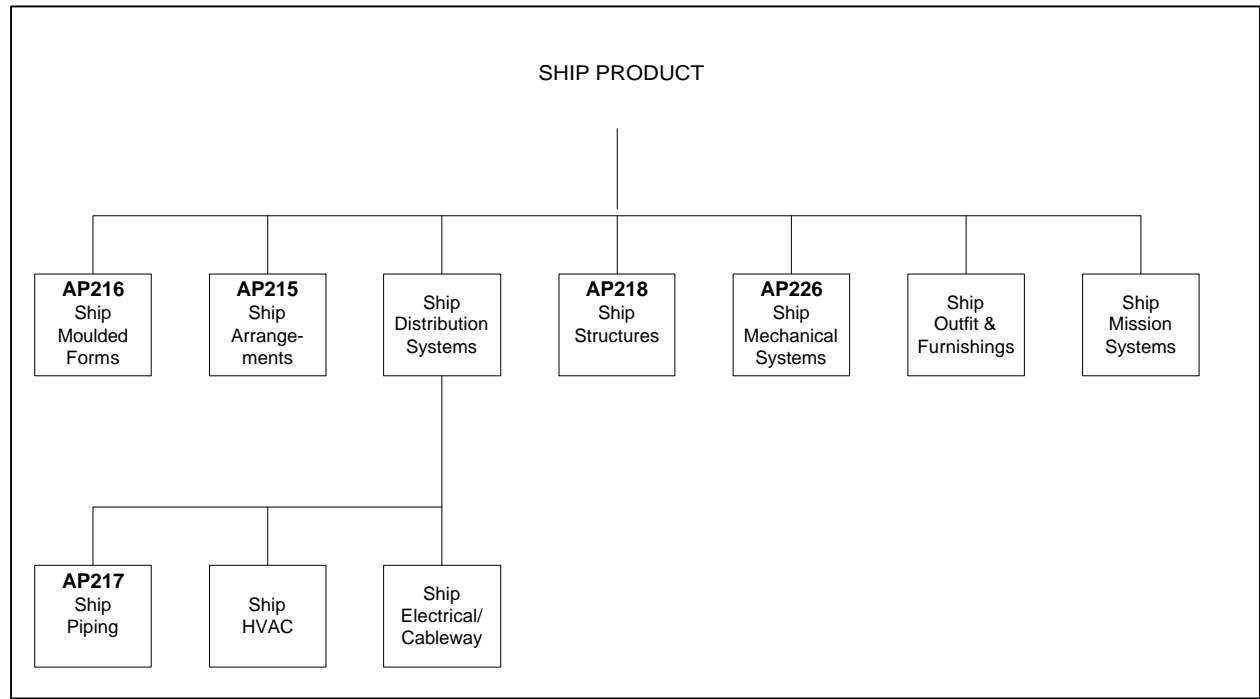


Figure L.1 - Ship product application protocols

Each separate system is described by one or more different application protocols. The development of these application protocols involves input from organisations from all aspects of the shipping community world-wide: shipbuilders, marine engineering component suppliers, shipowners, classification societies and so on.

L.2.3 AP226: Ship Mechanical Systems

The scope of the AP226 encompasses the following physical systems: propulsion systems, auxiliary systems and deck machinery including all of their major equipment. Each of these systems are currently broken down into sub-groupings in order to facilitate information capture for various components within the decomposition hierarchical structure. These are documented in Annex M of this Part of ISO 10303. AP226 will provide a life cycle view of the above systems covering information requirement from concept through design/selection, operation, monitoring, inspection to decommissioning (see Figure L.2). This life cycle view will provide a powerful infrastructure for developing data storage, data handling and application modules for concurrent engineering in shipbuilding and for ship-board systems and ship to shore data communication in shipping.

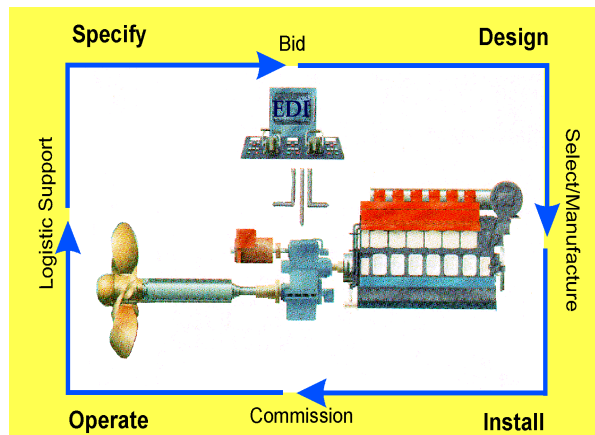


Figure L.2 - Schematic representation of ship mechanical system's life cycle concept

L.3 Concepts Common to Ship Application Protocols

ISO 10303-226 is being developed to support the exchange and sharing of Ship Mechanical Systems data. ISO 10303-226 has been developed in conjunction with other ship product application protocols so that important shipbuilding concepts are common and inter-operable within the STEP standard.

L.3.1 Mechanical Product Type Hierarchy

The method by which this part of ISO 10303 generalises and integrates the information spanning the domain of a large number of mechanical products (see 3.10.61) is via a hierarchical partitioning commonly known as a type hierarchy. The nature of such a hierarchy is that those objects close to the root of the hierarchy represent the more general objects, while those at the leaves represent the most specialised.

The main components of the type hierarchy employed in this part of ISO 10303 are shown in Figure L.3. Fundamental to the organisation of the information is the concept of the item (see 3.10.51) within the wider ship APs and the mechanical product within this part of ISO 10303. The mechanical product is a discrete identifiable thing with which definitions (see 3.10.32) and activities (see 3.10.2) are associated. It serves as the most general object from which more specialised objects are derived.

L.3.2 Definitions Type Hierarchy

Definitions describe mechanical products and are, as a result, the descriptive information-bearing entities of the model. A definition may be further classified as a physical, functional and so on definition. A mechanical product may have many different versions of definitions. The main components of the definitions type hierarchy employed in this part of ISO 10303 are shown in Figure L.4.

L.4 Architecture of the data model

The main structure of the data model embodied in the ARM of AP226 is characterised as the type hierarchies shown in Figures L.3 and L.4 in which general constructs (e.g. Mechanical Product, Definition) are successfully specialised in each lower level of the hierarchy. This characteristic provides both flexibility and a mechanism by which very specialised constructs (e.g. "diesel_engines", "RAM_data" and so on) can be described.

In addition to flexibility and the ability to selectively specialise concepts of interest, this structure provides the following advantages;

- The top levels of the hierarchy can be effectively integrated and aligned with the core concepts and facilities common to the entire set of ship-related application protocols, thus providing for the possibility of inter-AP integration.
- The mid-levels of the hierarchy can be specialised into constructs describing the major types of shipboard systems and equipment.
- The lowest levels of the hierarchy can be fully specialised into constructs to describe specific items of mechanical products (e.g. diesel engine,.....).

In dealing with ship mechanical systems, which are effectively a composition of hundreds and thousands of various mechanical products, the approach taken seems to provide a solid basis for capturing all the industrial requirements.

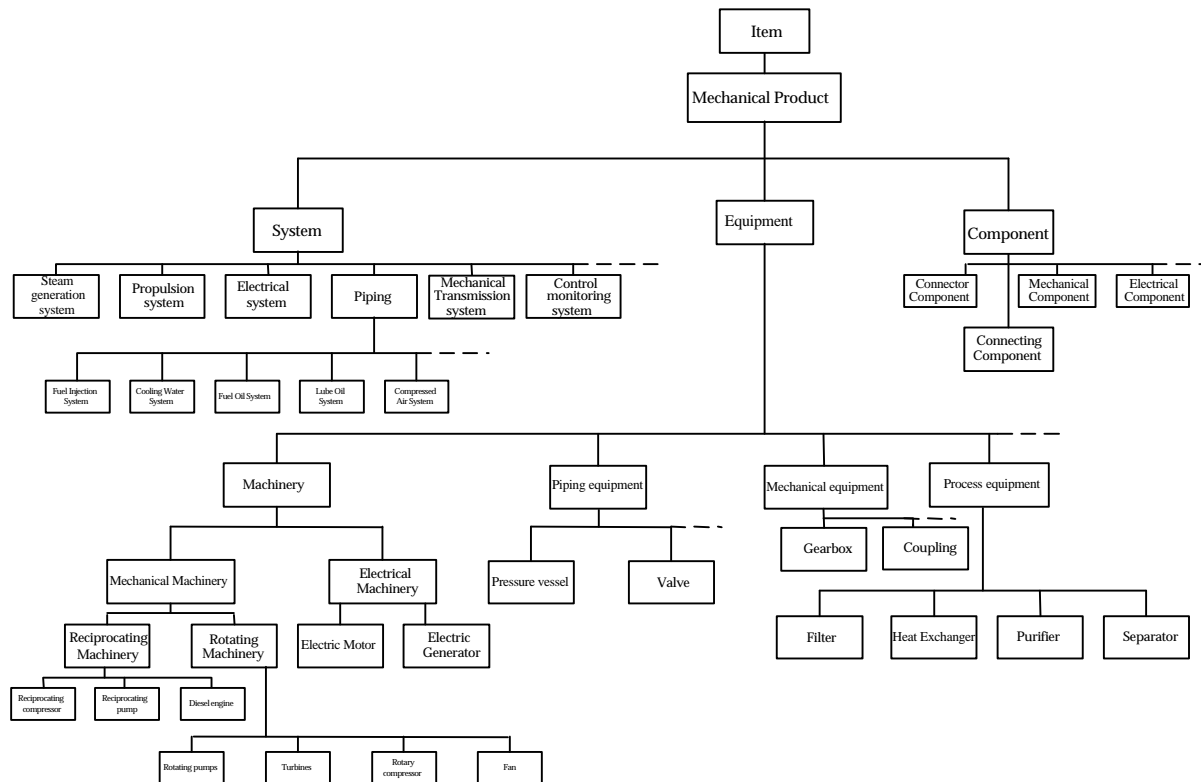


Figure L3 - Mechanical product

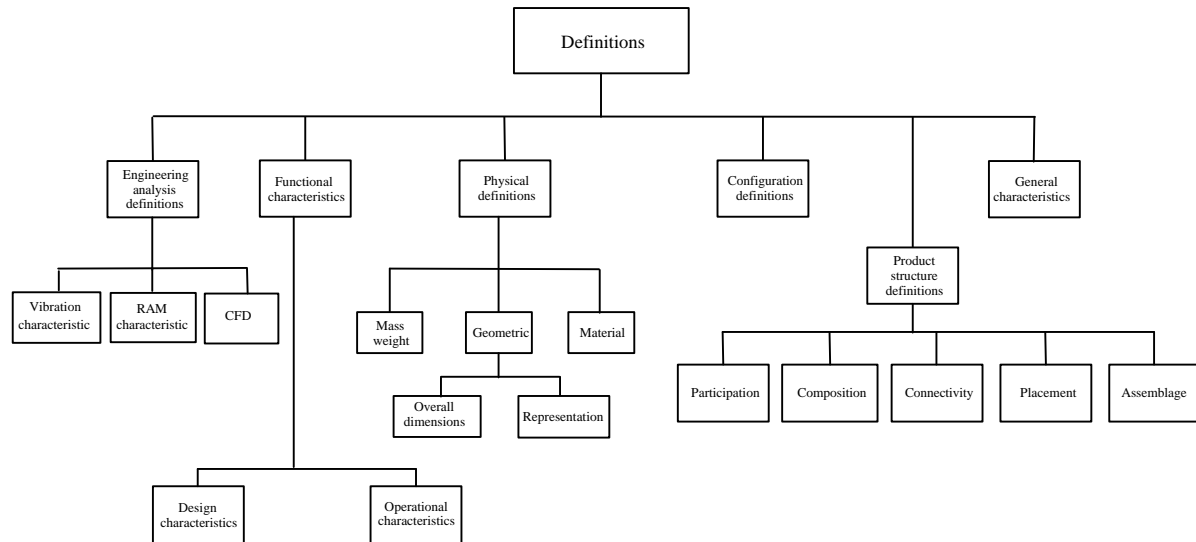


Figure L.4 - AP226 product definition type hierarchy

L.5 AP226 Data Planning Model

L.5.1 - What is a data planning model

A data planning model presents all the units of functionality (UoF) together with their major relationships (see Figure L.5). As such, it provides an overview of the Application Reference Model (ARM) without too much detail. It can be used to check whether the different components of the model fit properly together. It is generally agreed that such a data planning model is useful when dealing with complex product models such as those developed within STEP. The data models developed within STEP are documented in EXPRESS and EXPRESS-G and as such are not fully comprehensible to application experts. A data planning model can to some extent overcome this shortcoming.

This section presents the data planning model for AP226. The main audience of this section is assumed to be the application experts.

L.5.2 Data planning model

Figure L.5 shows the data planning model, representing all the AP226 UoFs. For definition of each UoF, please refer to clause 4.1.

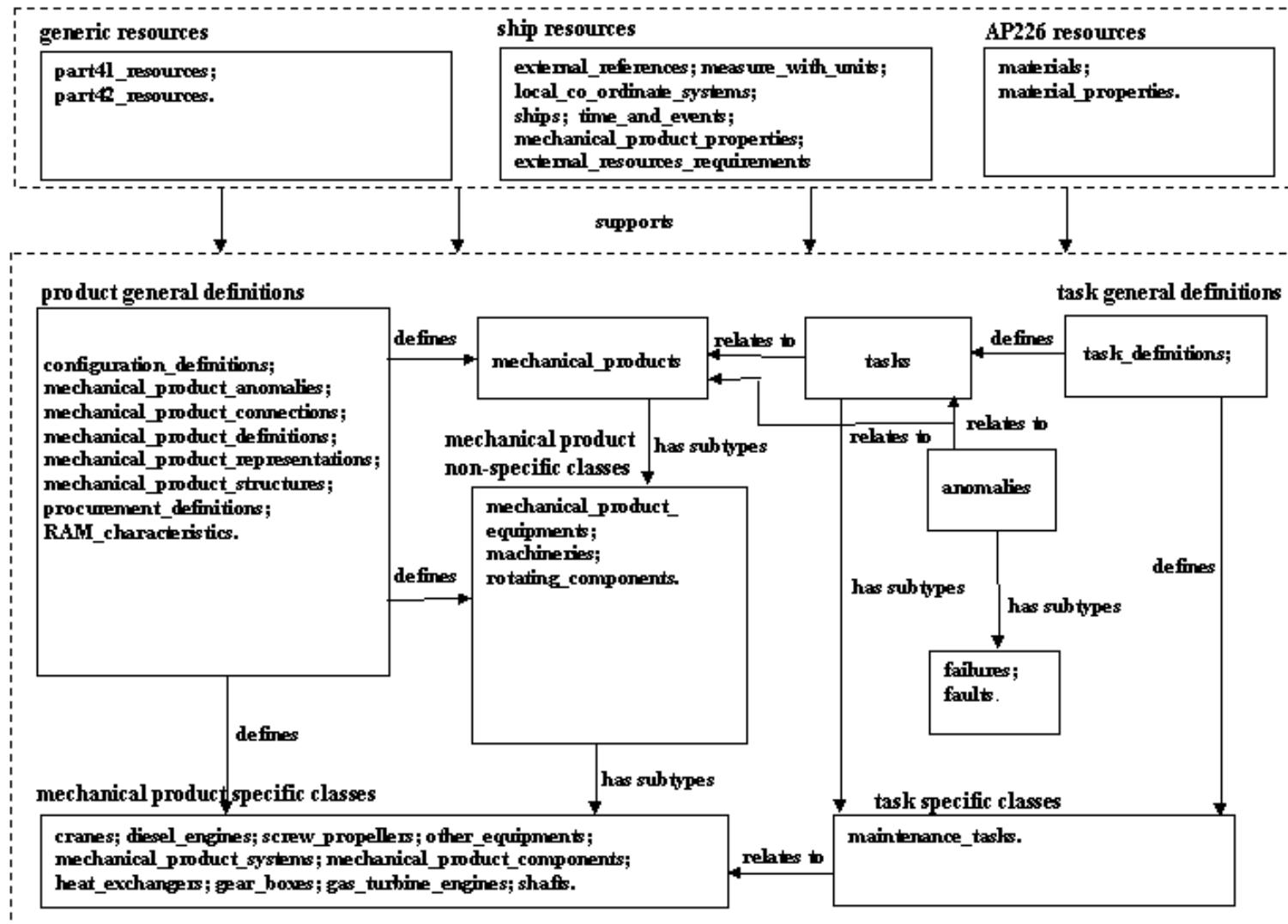


Figure L.5 - AP226 Data Planning Mode

Annex M (informative)

Mechanical System Breakdown Hierarchy

M.1 Introduction

The AP226 scope covers the ship's mechanical systems which include the propulsion system, auxiliary systems and deck machinery. The schematic representation of the scope of AP226 is shown in Figures M.1 and M.2 (not shown).

In order to make sure that the full scope of AP226 is covered, physical and life-cycle decomposition techniques were adopted. This annex provides details of the breakdown structure for selected mechanical products.

M.2 System Breakdown

The aim of the system breakdown (decomposition) is to identify all the physical sub-systems and components of a main mechanical product. In effect, it is a hierarchical decomposition which is carried out in a top-down fashion. The decomposition is carried out to the lowest component level for which information is needed to be exchanged. This lowest level is normally defined by exchange scenarios.

The breakdown is normally illustrated either by a block diagram or by an indented table, in which each component has been assigned a level to illustrate its position within the hierarchy as well as its parent-child relationship. The breakdown structure for selected mechanical products (diesel engine, propulsor, mechanical transmission systems and manoeuvring system) has been completed and is provided in the following sections:

M.3 Breakdown Structure for Diesel Engine

This has been documented in report TID_PE5220_DD1.0 dated 5 December 1996. *This report will be added here at a later stage.*

M.4 Breakdown Structure for Propulsor

This has been documented in report TID_PE5220_DD1.0 dated 5 December 1996. *This report will be added here at a later stage.*

M.5 Breakdown Structure for Mechanical Transmission System

This has been documented in report TID_PE5220_DD1.0 dated 5 December 1996. *This report will be added here at a later stage.*

M.6 Breakdown Structure for Manoeuvring System

This has been documented in report TID_PE5220_DD_addendum dated 20 February 1997. *This report will be added here at a later stage.*

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